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ABSTRACT

This report describes a marine studies program sponsored by the University of Hawaii. The publication presents the students' own stories of their experiences. An overview of the kind of program, student qualifications and requirements, and scope of the Marine Option Program (MOP) is included in the report. Details are provided relating to (1) the program's objectives, (2) its methods of operation, and (3) the progress it has made. The academic development, marine skill development, and extension of the program are discussed. A complete fiscal report is presented, both in descriptive and tabulated form, for the period March 1, 1972-August 31, 1973. (EB)

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FIRST BIENNIAL REPORT

MARINE OPTION PROGRAM

Sea Grant Miscellaneous Report
UNIHI-SEAGRANT-MS-73-02

June 1973

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This biennial report describes the Program sponsored by the University of Hawaii and NOAA Office of Sea Grant, Department of Commerce, under Grant Nos. GH-93 and 2-35243 and is being published with the General Funds of the Office of Marine Programs, State of Hawaii. The U.S. Government is authorized to produce and distribute reprints for governmental purpose notwithstanding any copyright notations that may appear hereon.

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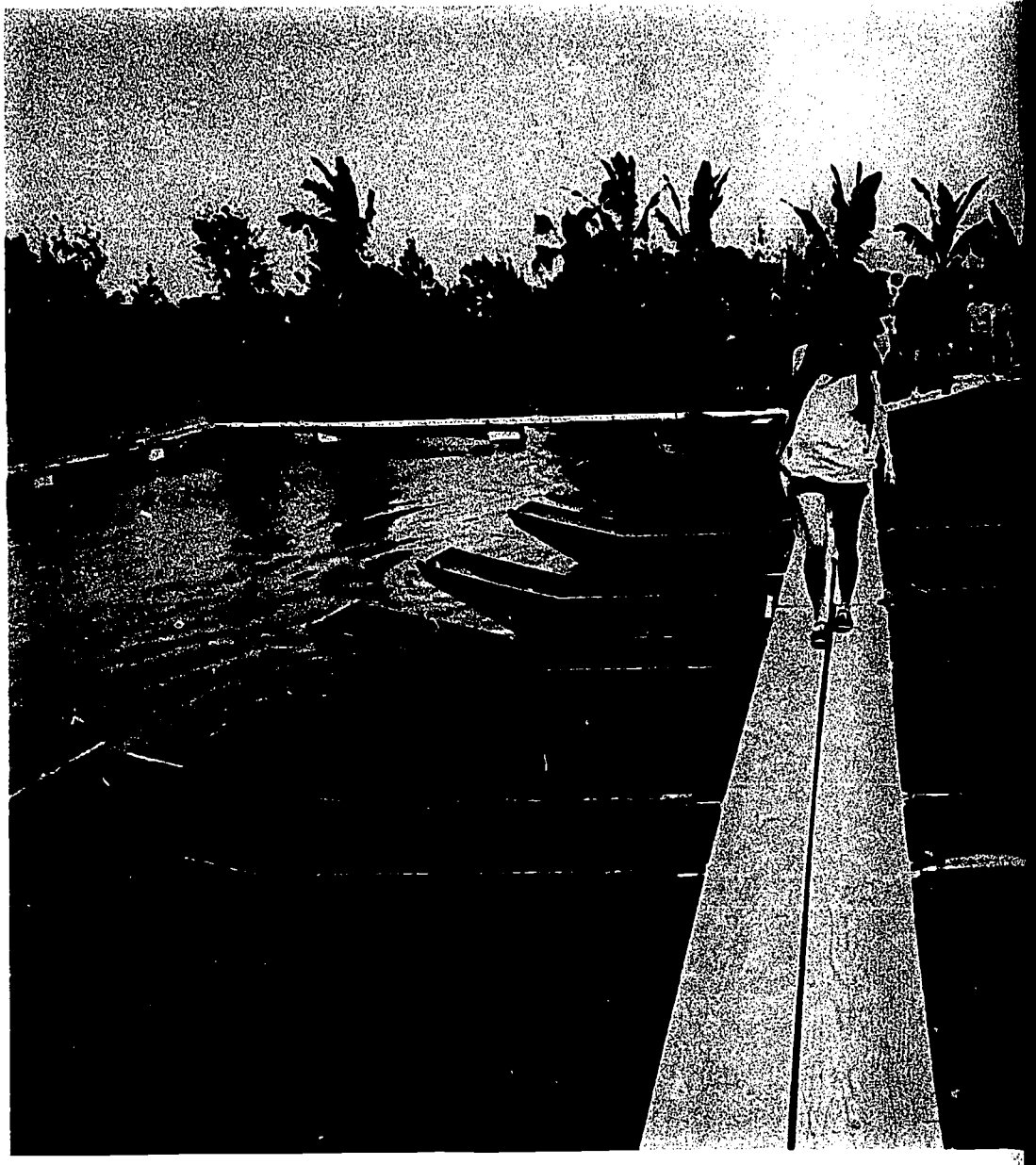
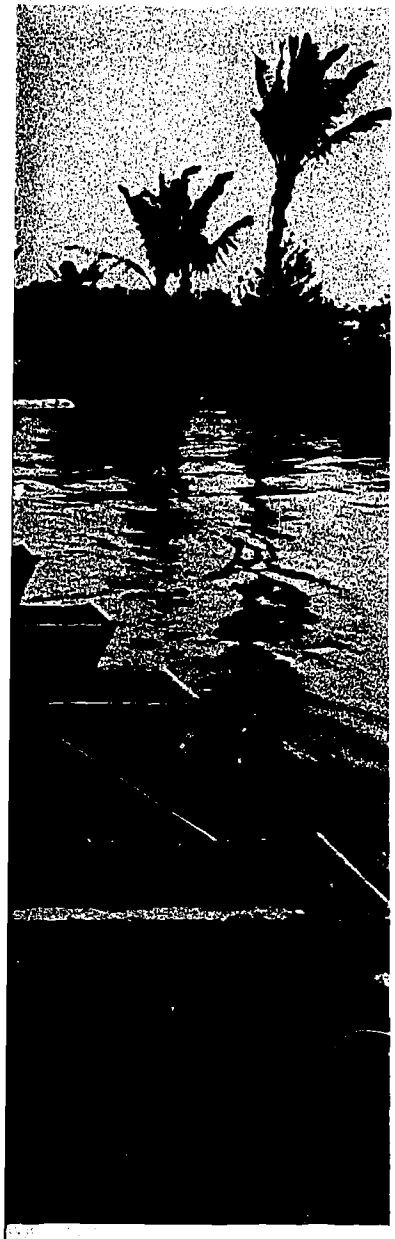




foreword...

The Marine Option Program, in its brief two-year history has spawned a diverse array of ocean-oriented activities and research projects for undergraduates, ranging from tours of Hanauma Bay to trips to Fiji aboard Hawaii Institute of Geophysics vessels.

The purpose of this publication is to give students from the various projects a chance to tell their own stories just as they happened. We have attempted to capture some of the sparkle and enthusiasm that flavor MOP experiences in prose and photographs. Interspersed where they actually participated in the development of the Program are the feelings of few key faculty members.

MOP has been the vehicle that provided guidance and incentive for many talented and highly motivated students. In many cases, it is likely that neither this talent nor motivation would have been discovered without MOP.

The dynamic and enthusiastic interaction between teacher and student, which has been the foundation for the Program's success, was difficult to capture in photo and prose. But hopefully, this spirit of cooperation which will continue to spark new ideas necessary to keep the Program relevant and timely is reflected in the pages that follow...

...and forward

overview

The only one of its kind in the United States, the Marine Option Program involves undergraduate students from any major field of study in courses and practical marine field activities, leading to the granting of a non-degree certificate indicating proficiency in a marine area upon graduation.

Each student enrollee must complete twelve hours' in marine-related courses by the time he graduates to fulfill program requirements. At the same time, he must gain proficiency in a marine skill. The Program is flexible to accommodate a wide range of interests pertaining to both academic and skill requirements. Currently, students are working as junior researchers in aquaculture, marine ecology, marine mammal training, ocean engineering, marine recreation, preparation of marine foods and underwater archeology, as well as underwater photography, scuba diving, small craft piloting, sailing, and underwater film-making, among others.

The students come from diverse fields of study, from English to Archeology, among others. Each student receives individual academic advising from both program coordinators and faculty at the University. He is encouraged to pursue his particular area of interest within the broad framework of marine studies that exist at the University. Many students gain skills in various marine areas without compensation; others are supported under a limited number of marine internships made available by Sea Grant.

The Program began in March 1971 with an innovations grant from the University of Hawaii. Sea Grant support became available in July of that year, and has been significant in aiding program growth and development. Currently, 300 students are enrolled at both the Manoa and Hilo campuses of the statewide University system.

introduction

The unique location of Hawaii in the Pacific, coupled with a tradition tied closely to the sea, creates an unparalled opportunity for study of the ocean. A marine orientation naturally appears in some aspects of all man's activities in these islands, and this is most noticeable at the University of Hawaii with its many and diverse programs in marine affairs. The University has been mandated to look to Hawaii's traditional use of the ocean to give focus and flavor to its present and future marine programs.

historical perspectives

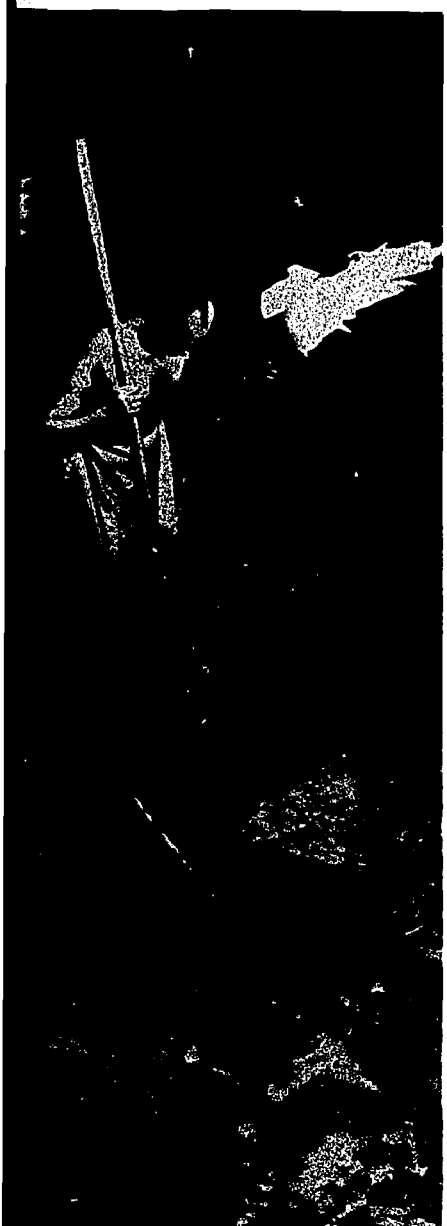
Much of modern marine educational activity in Hawaii has roots in the past. Ancient Hawaiian life was centered near, in, and upon the sea. Villages, scattered among the islands, served as centers of commerce in a barter and trade system. Reef fishing and coastal pond culturing of endemic fish supplied a good percentage of the people's needs. Swift canoes carried them between the islands. Navigators were superbly trained to use the stars, winds, and currents, to guide the sturdy craft with great accuracy. Lovers of the water, the Hawaiians swam and dove with great skill and invented surfing. This heritage, passed from father and son, places the Hawaiian people among the first marine educators.

The importation of Western culture caused a gradual change in the life of the Hawaiians. Interisland trade diminished in importance as developing commercial activity drew the population together in newly-created towns. Canoe construction and the training of navigators became less important. Fish ponds were neglected and became unusable. Turning more to the land for their livelihood, they turned away from the sea. Only ocean sport activities in which the Hawaiians excelled remained as a viable legacy from the past.

In modern Hawaii, then, much of the heritage of the people and most of the ancient crafts -- which were intrinsically bound to the sea -- have been lost. Fathers, for lack of knowledge themselves, can no longer pass on to their sons the tradition of the sea. Hawaii's young people, recognizing this tragedy, have been seeking ways to become involved in marine development and help revive Hawaii's traditional involvement with the ocean.

marine studies for undergraduates needed

Hawaiian youth has now come to view the sea as a resource possessing assets useful to man beyond providing a place to surf, swim, and dive. The potential for aquaculture to provide food from the sea, ocean mining, mass transit both under and on the surface, and floating cities, to name a few, have aroused the curiosity of the young people of Hawaii. They have also heard that the ocean has limitations, that it is a frail resource, endangered, possibly, by man's intrusion into its biosphere. Wanting to help solve this problem, they seek basic knowledge of the biological and physical characteristics of the ocean waters.



The young look to their schools to obtain information and instruction on the marine environment. They need answers to their questions on the relevance of Hawaii's ocean to the total spectrum of disciplines. In addition to students who wish to study the science of the sea, art, music, and literature majors seek to articulate their craft through an esthetic appreciation of the ocean as an art form.

Study of the ocean has traditionally been reserved for graduate students, as it is the policy of the University that a diversified background of study covering many disciplines is necessary before a student may specialize or narrow his academic interest. The rigorous and extensive training in mathematics and the sciences required in marine programs are generally beyond that which an undergraduate possesses. Many undergraduate science students, however, have expressed the desire to pursue, in some fashion, academic and experiential training in the marine field. Undergraduate liberal arts students interested in the ocean, and curious to discover what possible role they might play in future marine-related development, also seek to become more deeply involved with the sea.

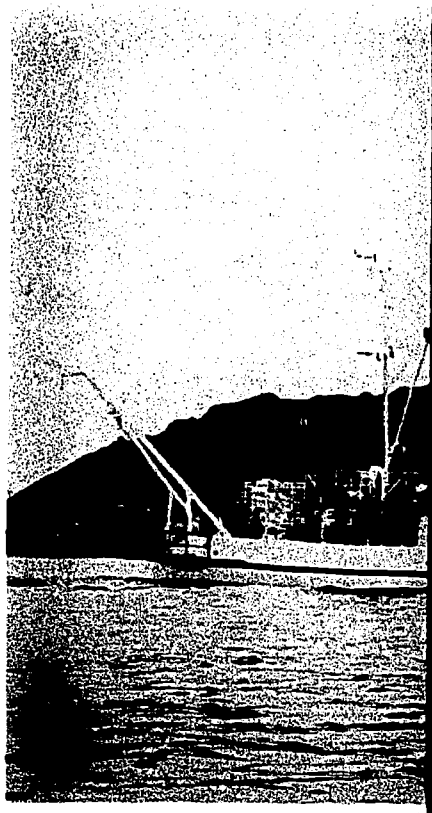
Recognizing the importance of involving undergraduate students early in their careers in marine-related studies were three key individuals at the University of Hawaii.

First to come forth was Harlan Cleveland who assumed presidency of the University in 1969. In his first academic plan, he recommended that the institution should strive for excellence in areas which are a "natural" for Hawaii. Identifying the "ocean" as a priority area, Cleveland proposed that every student should have at least a one-day exposure to some aspect of marine activity.

Upon assuming the dual posts of Dean of Marine Programs at the University and State Marine Affairs Coordinator in 1970, Dr. John P. Craven immediately saw the deficiencies in the undergraduate curriculum in opportunities for formalized study in marine science and technology and the lack of involvement of liberal arts students in the study of the ocean.

Dr. Jack R. Davidson who took over leadership of the Sea Grant Program in 1970 as the University's first Sea Grant Director, immediately began to gather resources to insure that undergraduates become involved in marine studies.

Cleveland, Craven, and Davidson wished to foster an awareness and appreciation of marine resources among the undergraduates, because, in their view, the economic vitality and quality of life in Hawaii would increasingly depend on wise use of the sea.



moving toward a solution

To merely increase the number of undergraduate marine survey courses would not solve the problem but would instead dilute the existing core curriculum. The undergraduate needs to focus his energy and time to achieve excellence in his major field of study. Therefore, the creation of a four-year baccalaureate degree in marine science was never in the design because such a degree program would tend to prod the student toward specialization at too early a stage. It would also discourage the liberal arts student from participating.

Nearly all departments at the University are influenced, in some degree, by the oceans. For instance,

Literature of the Pacific, a course in the English Department, is almost entirely directed toward the study of literature concerning Pacific peoples' dependence on the sea. The University catalog lists many other marine-related courses in various departments which are available to undergraduates. Students, however, either did not know of the existence of these courses or the relevance of the courses to marine education was not readily apparent.

Additional marine courses for undergraduates would, by themselves, be insufficient to meet student needs. Mechanical skills are an integral part of training in the marine field. Through a "hands-on" approach of being in, on, and around the sea, the student can begin to discover the assets and limitations of the ocean. It was therefore deemed essential that every undergraduate who wished to acquire a marine orientation should obtain a "marine skill."

Thus, out of a meshing of theory and practice evolved the philosophy and foundation of the MARINE OPTION PROGRAM. The Program began in March 1971 with an initial enrollment of 75 students. At present, there are 300 student participants at both the Manoa and Hilo campuses. The Program involves students in academic marine studies and practical marine skill-building activities. It is flexible, to accommodate a wide range of interests, and it helps the individual student achieve his personal goals in marine education.

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charles rolison: *It is satisfying for me to have people in the water and to have them learn something.*

During a class session in Hanauma Bay, Charlie Rolison explains the differences between the various specimens of coral found there.

Marine Option students gladly jumped into the project of studying and developing the marine recreation potential of Hanauma Bay. Even without any improvements, the Bay is a haven for snorkelers, both experienced and experimenting. And for good reason. The site is visually spectacular both from above and in the water. Looking down from the top of the hill, the lacework of submerged coral is a bright blue-green and craggy cliffs shelter both sides of the Bay. In the water, even waders can catch glimpses of the colorful conservation-protected fish that swarm through the reef.

Charlie Rolison and Lytha Conquest, both outfitted in snorkeling gear, examine a coral specimen from Hanauma Bay.

The Marine Option Program became involved with Hanauma Bay when it decided to follow up the Governor's task force report which suggested a marked underwater trail. The markers would allow snorkelers to identify the marine inhabitants of the Bay.

That was two years ago.

Charles Rolison, then a sophomore zoology student with a commercial diving background, joined the program to work on a project to install the now controversial and not-yet-installed markers.

"I thought I'd get about $50. I was figuring on a three-week undertaking," Charlie said.

He soon found himself involved in research on questions such as the impact of markers on the underwater environment and the number of people these markers would reach.

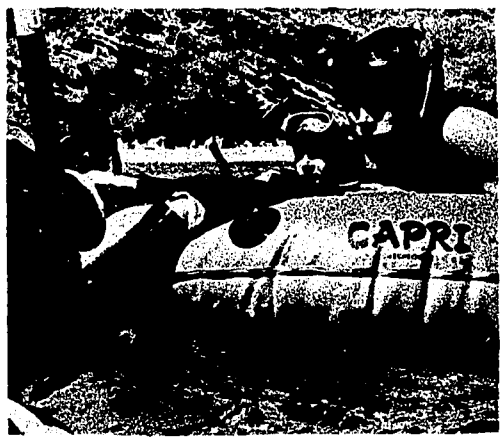
His thorough analysis of the Bay included entryways to the water beyond the reefs, currents, fish life, and corals. Originally, Charlie enlisted his brother as an assistant. Then Reid Withrow, another MOP student, worked with him. Now, they have an additional eight students from the interdisciplinary studies course, Living Wealth of the Oceans. (Charlie is a teaching assistant in that class and shares with the group what he has learned about marine recreation.)

Charlie admitted that he reached the point where he didn't think anything was ever going to be done with all the information he had collected. Then, the Bureau of Student Activities contacted him. It was interested in more activities for University of Hawaii's student body and liked the idea of organizing snorkeling tours of Hanauma Bay for 1972's summer school classes.

Altogether, between 1,500 and 2,000 people have gone out on the tours, Charlie estimated. Even after the summer ended he and his group of tour guides took out groups with special interests in the Bay. "Once in a while we take a zoology class," he said. "Recently we took a religion class that wanted a new experience. They were studying the phenomenological method on how to relate religious ideas to everyday activities."

In spite of the large number of people who have toured the underwater wonders of Hanauma Bay, there have been no accidents to speak of.

Members of a tour are required to wear life jackets. In addition, one of the guides on the tour is responsible for towing out a rubber raft so that anyone who needs help can be easily taken back to shore.



A rubber raft is towed along on all MOP diving excursions in Hanauma Bay. It serves as a safety precaution and conference center.

"The experience is fun for us, especially when local people, who have never been out in the Bay, come out," Charlie said.

This summer the Student Center will again offer the tours of Hanauma Bay and Charlie and three of his students will be paid to conduct the tours.

Another result of Charlie's tours is that the City and

County of Honolulu has adopted the idea and is going to sponsor a similar self-supporting program open to the public. Each person will be charged $3.50. "They'll get mask, fins, snorkel instruction plus the tour," Charlie said. "The fee is not really high. In Florida it costs $10."

Personally, Charlie is interested in staying in the marine recreation field in some way oriented toward diving. "I think it is important to have people who can enjoy marine resources without taking something out of them. And it is satisfying for me to have people in the water and to have them learn something," he added.

As far as the Marine Option Program is concerned, he commented that he "would really like to give the Program a plug. The Program leaders really do provide a great service for enhancing education. They have enhanced mine. They get people doing things."

carla miyamoto: *I don't think people are aware that the ocean has so much potential for the economy and for recreation.*

Carla Miyamoto was one of the girls who worked as a Hanauma Bay tour guide during the summer of 1972. "Whenever they had tours, I was there," she said.

Carla Miyamoto leaps into Hanauma Bay, leading a group of students on a marine life tour.

The attractions for her were "that I met the strangest people and I was in the water." She is fascinated by the ocean, which made up for the fact that the pay was minimal.

Through the Marine Option Program, Carla also got her scuba diving certificate last March. A project called the Mokapu Outfall Baseline Study was just getting started then and it required scuba skills which she didn't have.

She wasn't selected to be on the small staff that did the Mokapu study. However the diving certificate got her aboard the spring semester cuirse that year on the trimaran, AIKANE IV. Sponsored by the Marine Option Program, the group sailed from Oahu to the island of Hawaii, then spent a week sailing up and down the Kona coast.

During the cruise, Carla and the other divers aboard did

survey work for the County of Hawaii at Honaunau Bay. "It was both educational and recreational," Carla said. "We did transecting. We identified fish and coral."

She is working on her MOP certificate which she wants because "it shows I accomplished something." It has been difficult for her to complete all the necessary coursework, however, due to the popularity of the ocean courses -- they had been filled before she registered.

Carla is a sophomore zoology major this semester, but she is already certain that she wants a career that will "involve the ocean and diving." It can be either in the research field or "in trying to make poeple aware of the ocean. I don't think people are aware that the ocean has so much potential," she said, "for the economy and for recreation."

In spite of the fact that Carla has lived in Hawaii all her life and lived close to the ocean, with one uncle who was a fisherman aboard a sampan and a grandfather who "knew all kinds of things about the ocean," she claims that it took the experiences she has had with MOP to make her "more aware of the ocean and the animal life in it."

Carla's experiences have led to new involvement in the Program. She will be the student director of a new study of a man-created artificial reef in Oahu's Pokai Bay this summer.

robert western: *The 100-foot bottom is strange.*

The Mokapu Outfall Baseline Study started off informally. A few students were interested in doing an environmental study of the ocean on their own. Several students met with the Director of Marine Option Program to share ideas.

Robert Western, undergraduate zoology student, was appointed director of the project. Most of the participants were also undergraduates. The original objective of the project was to monitor pollution in several locations in Oahu's surrounding waters.

"We were using coliform bacteria as a measure and that isn't very accurate," he admitted. "All of the tests show that these bacteria exist, but they are not necessarily pathogenic. For every 2,000 coliform bacteria, three or four are pathogenic. A coliform count is not a good indication of biological pollution."

As originally planned, the group was to sample the water in 10 different locations. But this was beyond the time capabilities of the group, Bob said. So they switched gears. With the help of the Naval Undersea Center, the students began thinking about studying animal life in the waters off Mokapu Peninsula, the site of a new sewage outfall.

Students lay out a transect line along the 60-foot depth contour in Oahu's Kailua Bay, as part of a $24,000 NSF-funded study. MOP students proposed, implemented, and led the study themselves.

NUC provided a boat for the initial survey dive and gave the group access through the Kaneohe Marine Corps Air Station.

"Then we found out that the National Science Foundation Student Originated Studies Program was accepting proposals," Bob recalled. And the group was encouraged by the fact that a project in Hilo had been funded. "We worked day and night on that proposal," he said, "and it was accepted."

"As soon as we got the grant, we got all the people organized, 15 participants. We started with about 50, but we had to narrow it down because we couldn't pay that number of people. We did get $23,500, the second highest grant amount that was awarded by the Foundation," Bob said.

Each person was paid $960 for a 12-week period, a sum that worked out to $80 per week for a five-day, sometimes a 6-day, week.

The students encountered some adverse conditions in the waters off Mokapu Peninsula: They met the tail end of a hurricane and two tropical storms during their 12-week sampling period.

Sharks presented another problem. The student director described a day when some 30 sharks swam toward the divers. Although the sharks were chasing a school of fish, they left the novice sample collectors shaken. As protection, safety divers equipped with Farralon CO_2 shark darts accompanied every dive team.

The group collected data on the number and species of invertebrates, algae, and fish. Study results indicated that there was an abundance of commercial fishes in the waters. It also indicated a large concentration of fishes along the 100-foot contour level.

"The 100-foot bottom is strange," Bob said. "There are a series of boulder patch reefs which may or may not come in contact with the outfall."

The group also discovered that the invertebrate and fish populations maintained a balance -- no particular invertebrate or fish dominated the environment. The bottom was free of algae because a sea urchin, the *Tripneustes gratilla*, feeds on it. Should this sea urchin be destroyed, however, it would mean that

the Bay would begin to sprout a crop of algae.

Four people did the actual writing of the report: Kelvin Char wrote the section on fish, Carrie Matsuzaki wrote about algae, Bill Thomas wrote about invertebrates, and Bob tied it all together with pictures and an introduction.

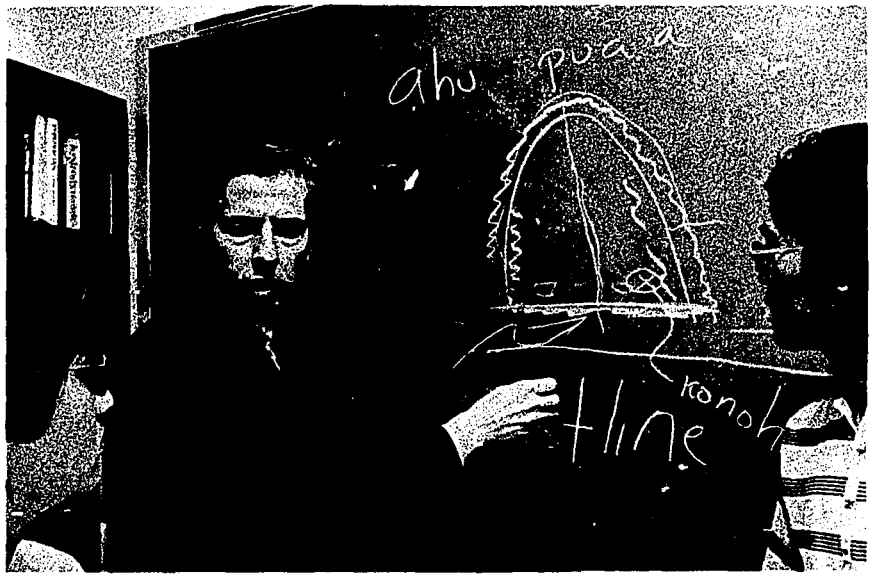
One of Robert Western's specialties is underwater photography, a field he plans to study in depth next year at Brooks Institute of Photography in Santa Barbara, California.

dr. john p. craven: *We should have environmentally pleasing ocean solutions.*

In Hawaii, Dr. John P. Craven is probably best known as the man who designed the floating city. He also happens to be the Marine Affairs Coordinator for the State of Hawaii and the Dean of Marine Programs at the University of Hawaii. The Marine Option Program operates under him.

In establishing MOP, he took the point of view that "the ocean is not a subject, it is a place. Therefore, every discipline can be included."

Craven believes that he was hired "to give Hawaii an ocean orientation. Hawaii thinks it is an ocean state, but it isn't," he said. "This is an island and the people cling to the island. Our ocean is a very rough ocean. Many people have drowned in it."



Dr. John Craven maintains close student contact by teaching an interdisciplinary course on man's relationship to the ocean called the Sea and Society.

About 300 students are involved in the Marine Option Program. "I think at least 10 percent of the student body should be involved," Craven said, "somewhere in the neighborhood of 3,500 students. It is necessary because Hawaii does nothing but employ mainland solutions to Hawaiian problems. This island is being destroyed by mainland solutions. Instead, we should have environmentally pleasing ocean solutions."

"The only way to do this," he continued, "is to have a significant number of people exposed to what can be done in the ocean. Ten percent is enough, because that 10 percent will be really turned on."

As far as students who have already chosen to study ocean science, he said, "One of our concerns is that so many students in graduate schools are a menace to others or a hazard to themselves. When they go out to sea, they don't want to admit that they have never been there before."

Therefore, he emphasized that students must acquire a marine skill to qualify for a Marine Option Program certificate. Not that he wants to make a formal discipline out of the marine skill -- "We don't care where they get their marine skills," he said.

"Then, when they get their degrees, they can go to graduate school or into a marine business with the right kind of background, having become familiar with the ocean in a personal way," Craven said.

thomas iwai: *I worked for about one year as a volunteer. MOP was tight on funds.*

The ancient Hawaiians were master fish farmers. They carried lava boulders to the ocean and built fish ponds that are still intact. What is left of Hawaiian legends reminds us how richly the Hawaiian people were rewarded with lush mullet crops.

Their mouths watering, modern scientists are taking a second look at island waters as a future source of food. And students like Thomas Iwai, a first year graduate student at the University of Hawaii, are serious about making aquaculture a life's work.

Tom has a bachelor's degree in zoology and was awarded one of the first Marine Option Program certificates. His marine skill: ichthyological research and fish classification.

It was through the Marine Option office, which placed him at a job with the Bishop Museum, that Tom was able, as an undergraduate, to obtain experience identifying fish. "I worked for about one year as a volunteer," he explained. "MOP was tight on funds."

That job was followed by a position under Dr. Joseph P. O'Reilly, a professor studying the psychological aspects of diving physiology at Makai Testing Range. Tom was "hyper-

baric chamber operator, filling in divers on what they were going to do and what they were going to be tested on."

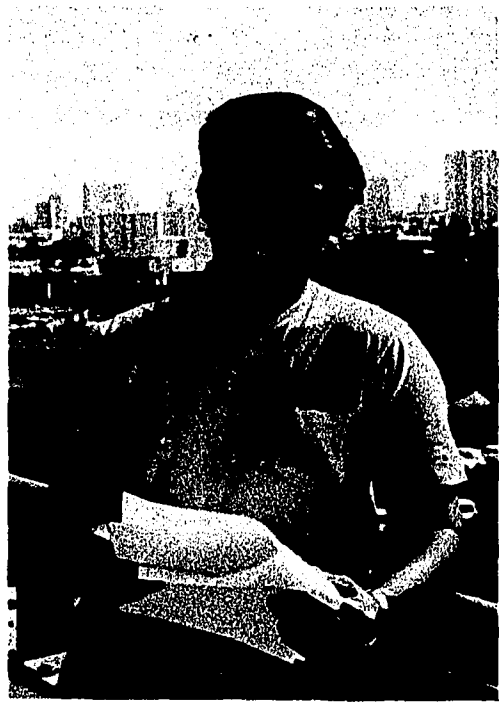
Eight other students, five of them MOP students, went into the chamber which simulated underwater diving conditions. There they were exposed to argon, helium, and nitrogen mixtures to measure the effects of those gases.

Now Tom is conducting preliminary nutrition studies on *Macrobrachium rosenbergii*, a genus of giant Malaysian prawns. In addition, he is still working as O'Reilly's research assistant.

Tom calls the Marine Option Program "the best marine-oriented program ever developed by the University. It provided me with the opportunity to gain experience in my field of study. I wouldn't have had the chance to work at the Bishop Museum if it weren't for this Program. It's a good Program and I think it should receive more recognition than it has."

"Since high school," he continued, "I have been interested in such a marine program. At that time none was available. Thus, when I entered the University, I enrolled in the Marine Option Program."

Even with his MOP certificate in his pocket, Tom is still actively involved with the Program. He is one of the teaching assistants in Dr. John Bardach's I.S. 298, an interdisciplinary studies course called Living Wealth of the Oceans. It was designed as an orientation course for MOP students.



Thomas Iwai has acquired a diverse array of marine skills in aquaculture, politics, fish identification, and diving training as a MOP student.

"One aspect of the course is that MOP students volunteer to intern as teaching assistants. I'm one of them," Tom said. The others who are working with him on the same basis are Charles Rolison, Rick Wilson, Kelvin Char, and Watson Okubo.

"Each teaching assistant conducts his class in his most qualified field," Tom explained. "Charlie is taking the recreational aspects of the marine environment. Rick Wilson is involved in fish and game regulations. Kelvin is doing a population dynamics study of coral reefs and Watson is studying the water quality environment."

Tom's group is working on aquaculture.

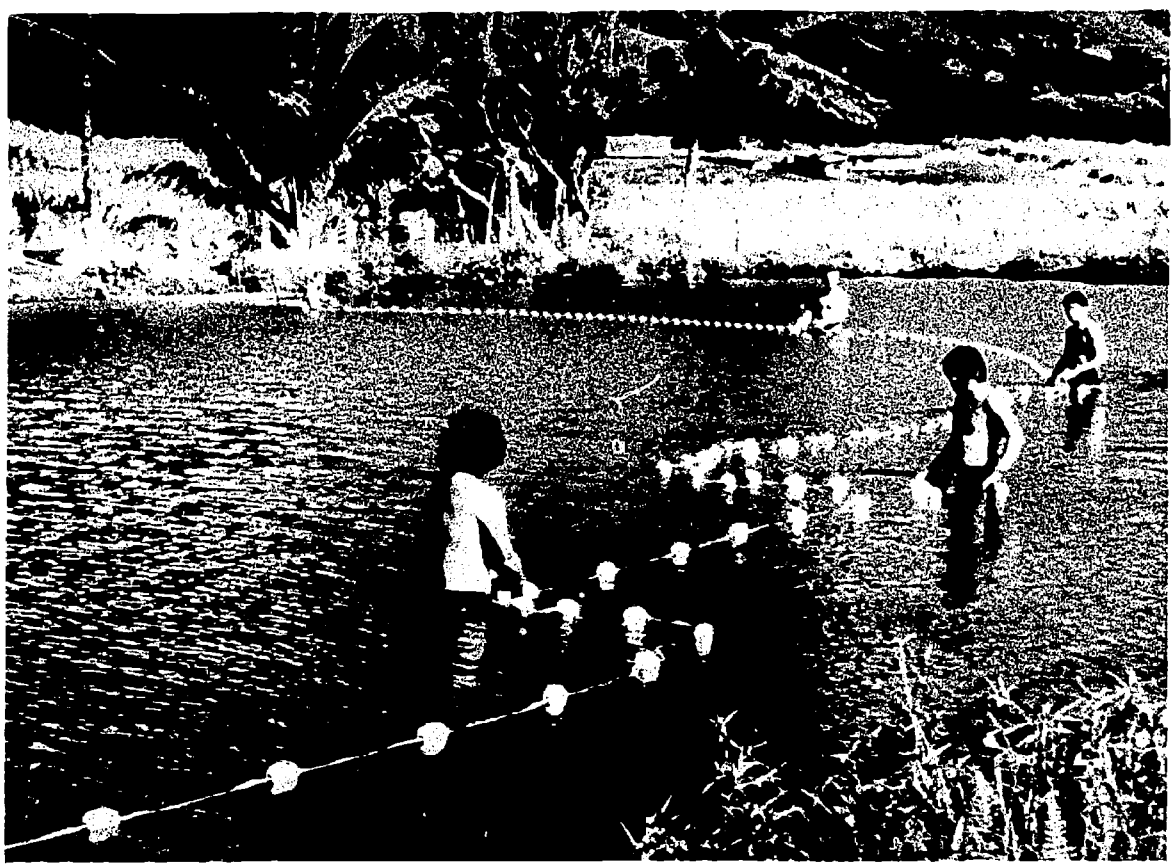
gary oura: *The more you know about the total field, the more techniques you can apply.*

Gary Oura, another serious aquaculture student, was allowed to participate in a special crash course in aquaculture sponsored by the East-West Center.

"I was interested in aquaculture and was taking a course in the economics of aquaculture. Through MOP I learned about the possibility of learning more about prawn culture," he said. He was admitted and was even given a stipend for the five-month duration of the course.

The whole matter wasn't quite that simple, however. "In this program," Gary said, "they weren't going to have any students from Hawaii until the Director of the Marine Option Program intervened. What he did -- getting two MOP students registered -- was quite a feat considering the financial situation of the state."

The East-West Center course concentrated on the raising of giant prawns, *Macrobrachium rosenbergii*. Students from Thailand, Malaysia, Cambodia,



Students in an East-West Center fishing program get field experience harvesting prawns on an Oahu prawn farm.

Mauritius, and Tahiti participated. They got their instruction from Takuji Fujimura, a member of the staff of the State Division of Fish and Game. "Fujimura," Gary said, "is known for his skills in *Macrobrachium* culture."

Gary and Howard Deese, the other MOP student involved, began their studies under Fujimura in June 1972 and ended in October of the same year.

"We went to the Maui Fish Farms for a week," Gary explained. "We worked along with them. We did the everyday farm work. And we had a lot of roundtable discussions with the manager and the biologist."

Students also worked every Tuesday at the pilot farm run by a private farmer in Punaluu. In addition, the young men worked an eight-hour day the rest of the week at the State of Hawaii's Anuenue Fisheries Station run by Fujimura on Sand Island.

"We spent a week at Oceanic Institute," he said, "to learn mullet and phytoplankton culture. The more you know about the total field, the more techniques you can apply."

Another facet of the program was going to Coconut Island and talking to the various scientists doing research there.

With all this experience Gary will soon begin working on a prawn raising project on Oahu for Global Marine.

"MOP made me more aware of the programs in the field of marine biology. It is a good middle point for the undergraduate. It helped me arrive at my goals; it made me more aware of the opportunities for people like me," Gary said.

dr. jack r. davidson: *Any student in any discipline can have a marine option.*

Dr. Jack Davidson, Director of Sea Grant, has provided vital support and guidance for the Marine Option Program.

As Director of the University of Hawaii Sea Grant College, Dr. Jack R. Davidson has been one of the key people responsible for funding the Marine Option Program.

In explaining why he has lent such strong support to the Program, he said, "Students have the energy and the desire to do something relevant, but they rarely have the opportunity to touch base with the real world during their college careers. We are not trying to

make oceanographers out of them, but the ones in ocean studies will be better oceanographers. And when the other students get to be Hawaii's legislators and decision-makers they will have a much greater awareness and appreciation of ocean resource values."

Sea Grant endeavors to start new and meaningful programs by supplying the initial funds, Davidson explained. He looks forward to having the University make MOP one of its top priorities, "so any student in any discipline can have a marine option."

doug pendleton: *Getting students into the environment is probably the best investment we can make.*

Tourists must pay for a leisurely two-hour motor-sail from Kewalo Basin to Diamond Head and back, but local high school students can take the same ride without charge aboard the University research ship, TERITU. And furthermore, they are able to participate in basic oceanographic experiments while on board.

In an experiment that vividly demonstrates effects of underwater pressure, a styrofoam cup is attached to a weighted line and lowered into the ocean; when it comes up, students pass around the small lump of compressed matter that is left. In another demonstration, a plankton net is towed behind the TERITU and the catch examined under microscopes right in the cabin.

A device known as a bottom drag is lowered to the ocean floor where it picks up bits of loose coral or even beer bottles. One cruise produced several pieces of precious black coral. Water temperature readings are taken with a bathythermograph at the surface and below to demonstrate how temperature drops dramatically with increased depth.

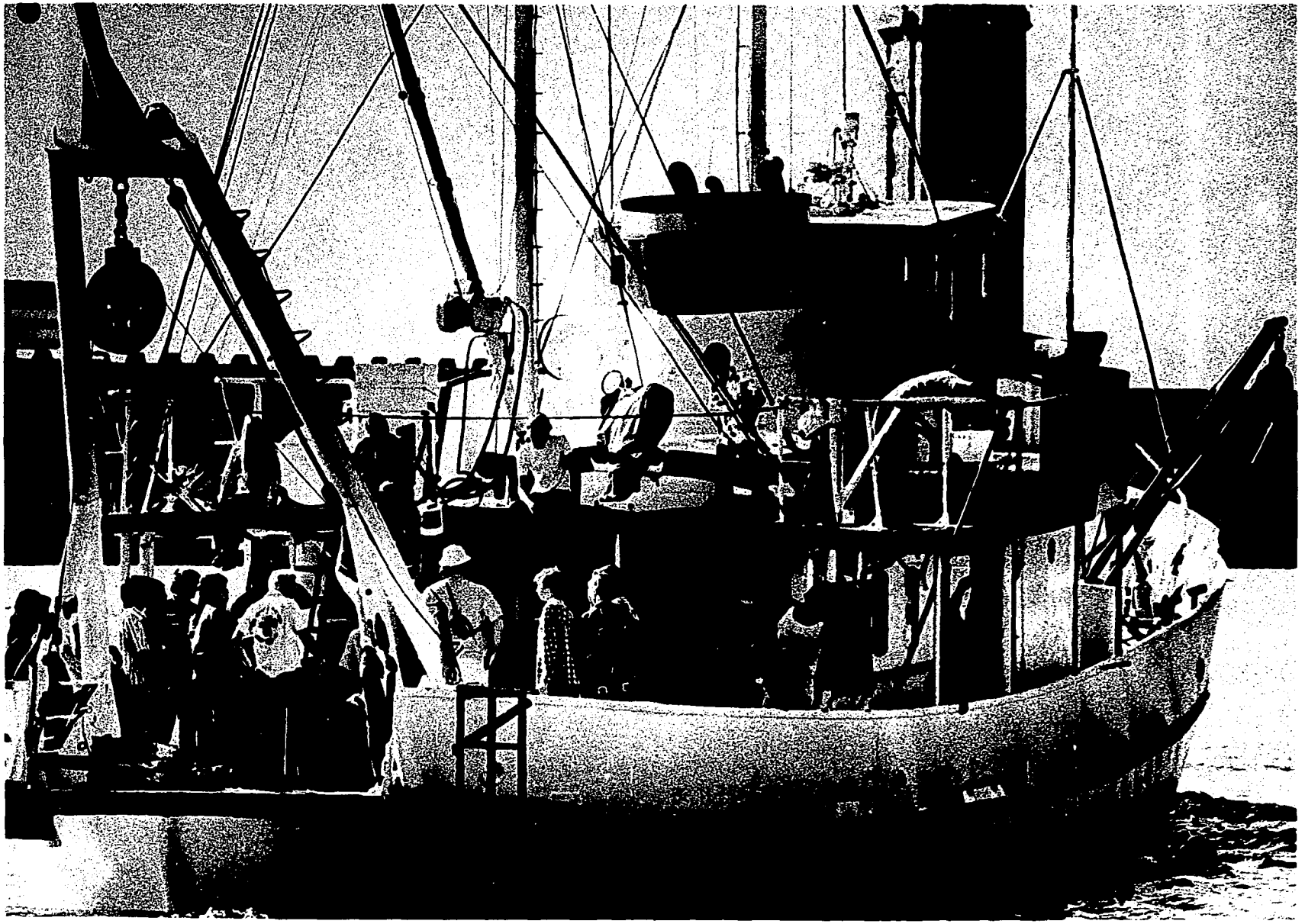
"We're not trying to make scientists out of the students. We're trying to introduce them to the sea," cruise director Doug Pendleton explained. It doesn't bother him if the high schoolers enjoy the cruise simply for the wind and the sea spray. It's the exposure that matters. "Students should gain an appreciation of the environment they live in," he insisted.

In two years, 1,100 students have been out on the TERITU. MOP has organized six trips to the island of Hawaii, one to Maui, two to Molokai, and several around Oahu.

Doug recalls one voyage when students wanted to learn more about mesopelagic fish -- fish that live between 600 and 1,000 feet beneath the surface of the ocean.

"There are weird, weird fish down there," he said. "They have jaws that fold out and built-in lanterns to light their way. There are teeny, teeny sharks with green eyes that glow in the dark."

That group of students did two-hour bottom tows around the clock for 48 hours to collect



The R/V TERITU is being used to introduce high school students to the ocean and its potential. During cruises basic oceanography equipment and basic research techniques are demonstrated. Here 25 high school students embark on an oceanographic orientation cruise.

specimens. According to Doug, they took their samples back to shore with them and are still studying the results.

This is exactly the response that Doug and MOP are trying to stimulate under the new Blue Water Floating Lab Program. The plan is designed to provide classroom curriculum materials for teachers so that the cruises will have more meaning.

As an education major with a special interest in marine subjects, Marine Option student Doug Pendleton will receive a Sea Grant graduate assistantship next fall to produce these materials.

The whole idea of cruises and related classroom materials "wouldn't have to be a program just for students in Hawaii," Doug said. "Students may have a chance to go to other places. Maybe there could be an exchange program, a dialogue between students in Hawaii and those on the mainland.

He also plans to develop materials that could be used for other non-scientific interest areas. "A cruise could be science-, or arts-, or sociology-, or history-related," Doug said.

From his student teaching experience at Kailua High School, he has found that "what kids like are meaningful activities."

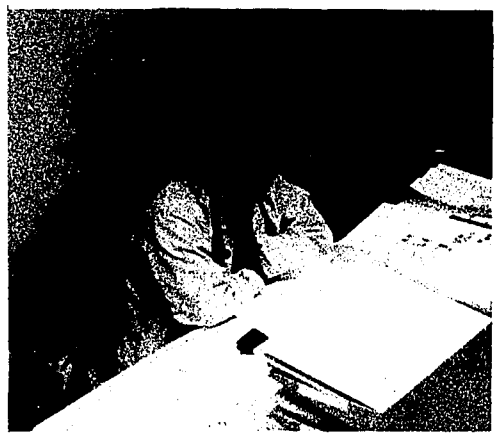
"It is very difficult to interest students if you try to talk about pollution in a classroom. They pass it off. They don't feel the need that the problem has for them and their talents. It doesn't just apply to the problems either," he emphasized. "It applies to the beauty of the island, too. Getting students into the environment is probably the best investment we can make."

donna noborikawa: *I work behind the scenes.*

Marine Option Program students get MOP news delivered to their doorsteps. It gets there via the *Hotline*, a weekly newsletter that is written, typed, and edited single-handedly by zoology sophomore, Donna Noborikawa.

Donna replaced Nancy Jones, an English major, as MOP news reporter for the *Sea Grant Newsletter* before assuming the editorship of the *Hotline*.

She has acquired other marine experiences, however. She trained for the Mokapu Outfall



Donna Noborikawa writes and edits the Marine Option Program newsletter, Hotline.

Baseline Study and learned fish identification. Now, she is taking a scuba diving course.

Although Donna is paid for producing the *Hotline*, she started working for MOP last summer as a volunteer. "I heard they needed help working with the high school orientation program," she said. "I'm an advisor along with Alan Hong, but he does the speaking. I work behind the scenes."

"We're there to make sure they don't overstep their bounds," she said, describing the advisory position. When the high school Kamalii O Kai group wanted to clean the Ala Wai Canal themselves, "we suggested they ask other social and science clubs to help."

As advisor, Donna has also been involved with high school cruises aboard the TERITU. She is very interested in the fact that MOP is planning to use three female cruise directors. "At present, we have only men," Donna said. "When girls come on board, they feel it is male-oriented and not open to women."

She feels that "the main thing that scares girls about a science career is men scientists. There is a lot of competition. Men don't like girls to compete with them."

But Donna hasn't let that discourage her. She plans to do graduate work in aquaculture and make a career of research in that field.

bill chase: *Too many people don't understand the dangers of boating.*

The course in boating safety and seamanship offered at the University is as ocean-related as anything can get. It definitely is a class MOP students can credit toward their certificates.

Bill Chase, in charge of public relations, public education, and communications for his flotilla in the Coast Guard Auxiliary, organizes the evening course on a volunteer basis. It has been given three times so far and will be offered again this summer. Each time, he has had capacity registration.

Bill is delighted with the response because, as he said, "Too many people don't understand the dangers of boating." He added that "this is a very elementary course. I try to get people to continue and join the auxiliary. I'm there every night. I pick the best instructors in the district, but if any of them don't show up, I teach the class."

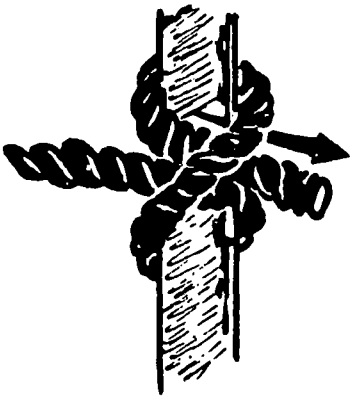
Bill schedules himself to teach five classes anyway. They relate to boating safety and cover rules of the road, use of charts, and use of a marine compass.

Other classes deal with nomenclature on boats -- legal requirements, fire safety, equipment, and aids to navigation (such as buoys, lights, and beacons).

Commander Bill Chase of the Coast Guard Auxiliary trains many MOP students in small boat handling and piloting.

"We teach them how to read a chart, plot a course, take bearings, tie knots, know details of sailboats and weather, and use the radio-telephone properly," Bill said. "We get other organizations, such as the Honolulu Fire Department, to work with us. They give lectures on explosions and the various causes of them."

At the end of the 13-week course, the class meets for a no-host dinner where certificates are awarded.



clove hitch

roger peterson: *Careful analysis and design of an integrated water vessel/bus system can provide an efficient, reliable, and comfortable mass transit system.*

"Use of the waters of Leeward Oahu and the canals of metropolitan Honolulu is possible and competitive block speeds can be attained. Careful analysis and design of an integrated water vessel/bus system can provide an efficient, reliable, and comfortable mass transit system," Roger Peterson wrote in the conclusion of his HEART (Hawaii Environmental Area Rapid Transit) study.

The entire 10-part volume which Roger produced as an undergraduate with the help of three other MOP students -- Marlene Spencer, travel industry management major; Gene Konrad, business major; and Hollis Wright, economics major -- is impressively thorough. It begins with a summary and proceeds to cover topography and population, vehicles, construction and capital cost, economics and finance, legal

and political concerns, environmental aspects, and the actual operation of such a system.

Marine Transportation for the State of Hawaii was the subject of a study by Roger Peterson, undergraduate business major.

"I am pushing for the use of the hydrofoil in Hawaii," Roger said, adding that it is a feasible mode of transportation both around Oahu and between the other islands in Hawaii's chain.

The problem of the roughness of the Molokai Channel has been over-rated, according to Roger. "It is rough for a yachtsman," he said, "but we're not dealing with yachtsmen. The Navy hydrofoil can deal with 35-foot waves."

In the process of compiling the study, he became something of a local expert on hydrofoil and hovercraft. He wrote to companies and countries which were working with the vehicles and managed to complete the report within a four-month period.

It is only fair to add that Roger was not a typical undergraduate. He is 38 years old and came to the University with a background in air and ground transportation. He returned to school to get a bachelor's degree in business administration because "accountants have great influence in society."

However, instead of business administration, Roger decided to begin work on a master of science degree, possibly a Ph.D. in the interdisciplinary transportation program offered at the University of British Columbia.

"I plan to write and to continue my research," Roger said. "I don't know exactly what I plan to do, but it will be in practical aspects of transportation."

He readily conceded that "MOP is what generated all of this. It started me off. If it hadn't been for MOP, I probably would have banged through college and then wandered off."

First, Roger worked in Dr. John Craven's office and helped with the financial planning and costing of Craven's floating city model. While in that office he picked up an article on hydrofoils that he felt was completely wrong and set out to disprove it.

Roger is currently doing an article for *Hydrofoil and Hovercraft*, an English publication. He is also a graduate assistant to the Dean of the College of Business Administration.

ted livingston: *Sailing involves so many different things.*

Sailing became a part of the Marine Option Program at the very start. A surprising number of students who were born in Hawaii had never been beyond its shores. They clamored for a sailing experience.

In cooperation with MOP Ted Livingston, the sailing team coach, chartered the square-rigged barquentine, CALIFORNIA, for three days and took out students on free three-hour cruises each day.

Sailing classes were initiated at the University of Hawaii under the joint sponsorship of MOP, the UH sailing club, and the Campus Center Board.

Those were the days of large budgets. But in the summer of 1971, University spending was slashed and since then there has been no money to charter anything.

Nevertheless, much enthusiasm was uncovered on those initial cruises. In response to a questionnaire, students almost unanimously asked for more sailing courses. "We told them to come to sailing club meetings," said Ted. "We have a roster of people who want to crew. If you participate that way you can learn by osmosis."

That didn't settle the matter. "The demand became louder and louder for a more formal opportunity to learn to sail," he continued. Finally, sailing courses were held for the summer school classes of 1972. It was a two-week program that students could elect to take either mornings or afternoons.

The Campus Center Board of the University, responsible for student recreational activities, purchased six sunfish for the course. Money for a trailer to haul the boats came from the Marine Option Program budget.

The whole venture actually cost the University very little, Ted explained, because students were charged $25 each for the course and these fees paid for the purchase price of the boats, the instruction, and the van.

Yet, in spite of the enormous success of the sailing course, both in terms of student enthusiasm and financial feasibility, Ted commented that it is still not adequately funded. Even for the sailing team which he organized in 1969, there are no facilities for keeping or mooring boats. What he would like to see is a formal arrangement in which sailing is offered through the Health and Physical Education Department.

One possibility that Ted is hoping will materialize is a proposal from the City and County of Honolulu that would allow sailing teams and classes to use the beaches for storing boats if the University in turn would loan boats and instructors to a County program for one day a week.

Another plan that could be even more useful to the sailing program is for some type of marina in Kaneohe Bay.

"The Marine Option Program has taken on the project of exploring the feasibility of using Dr. John Craven's floating city model as a marina," Ted said. Students are looking into engineering problems and what is necessary for a no-cost beginning.

"If we got the floating city, we could operate with five dollars," he said. "We would eventually need other amenities such as floats for the boats to be pulled up on -- those would be easiest to expand on a triangle. If we had $10,000, we would really be in business."

He added that Dr. Craven has "indicated that this is a sufficiently important subject for study" and that he would back the use of his model as a marina. Kentron Hawaii, Ltd., the firm planning inter-island hydrofoil transportation, has also indicated, according to Ted, that it would be interested in finding out whether or not this type of facility could serve as a landing point for its hydrofoils. Then, passengers could be ferried to and from the shore by small boat.

In the planning of such an experimental venture, MOP students from all disciplines would be able to apply their talents, he pointed out.

"Even just sailing involves so many different things," Ted said, "carpentry, metalwork, painting, working with cloth in sails, ropes -- lots of different activities that require the use of the brains and the hands. Just getting your equipment ready presents a great deal of challenge."

To sail, a person needs basic skills in meteorology, tides, currents, and "making the boat go where you want it to go."

dr. ross pepper: *If you won't eat it, don't feed it.*

A unique course in the training of marine mammals, dolphins, sea lions, even whales, is open to Marine Option Program students. Taught by Dr. Ross Pepper,

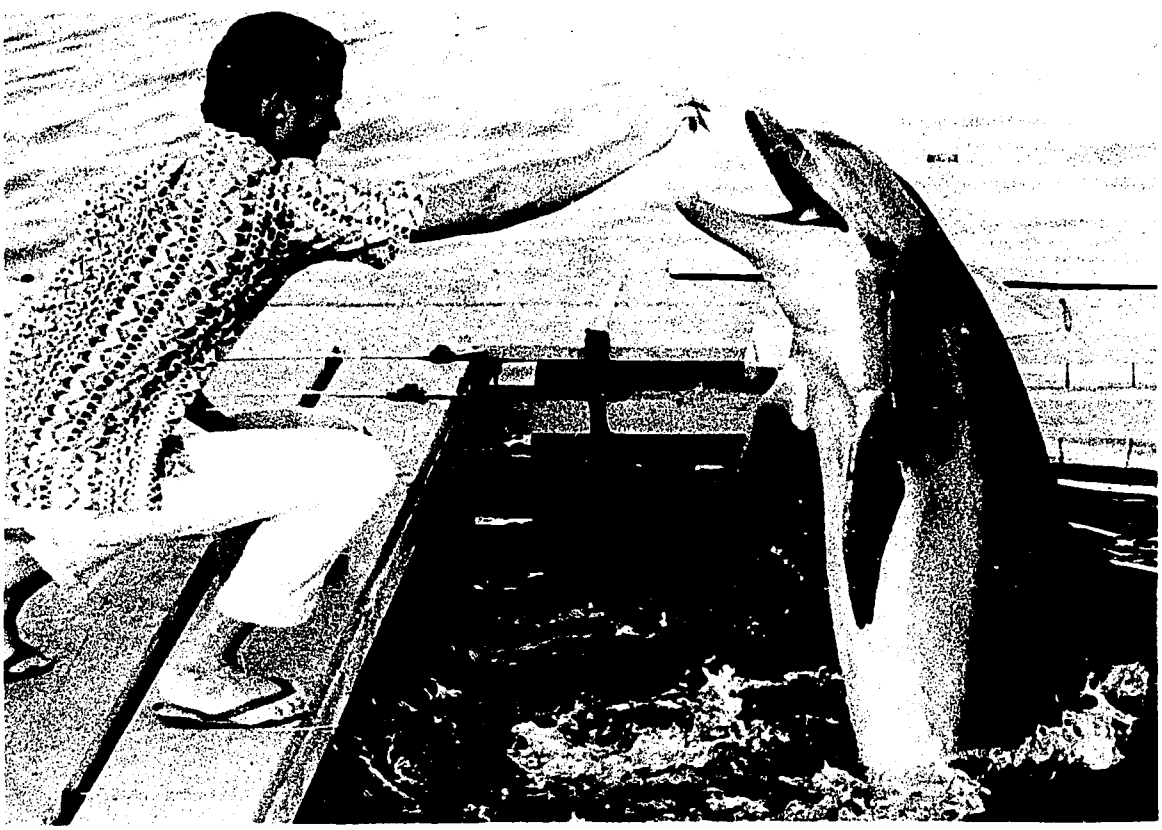
research psychologist at the Naval Undersea Center (NUC), it is probably the only course of its kind anywhere.

According to Dr. Pepper, marine mammal training has been an art form in the tradition of the circus. One old-line circus performer would pass it on to another. But his course has started a new tradition of sorts.

It is significant that Dr. Pepper is the first psychologist hired by NUC to work with marine mammals. Even Navy trainers had previously learned their trade in the commercial world, most recently in oceanariums that began to spring up in the 1960's.

Pepper's course is a 10-week program that meets on Monday nights and begins with an explanation of why the Navy is interested in marine mammals. Required reading includes marine mammal training manuals and *The Analysis of Behavior,* by James G. Holland and B.F. Skinner, one of the first programmed textbooks on behaviorist terminology.

Before getting into the course material, Dr. Pepper gives students the Bio-Systems General Information Test -- a measure of their knowledge of anatomy, physiology, taxonomy, distribution and morphology. Later, a post-test is given to measure what they have learned.



Porpoises at the Naval Undersea Center get part of their training from MOP students. Here Gene Bennington is feeding an eager mammal.

One of the most-emphasized lessons is the nutrition and feeding of marine mammals. At NUC marine mammals don't get candlelight dinners, but they do get restaurant-quality fish.

"If you won't eat it, don't feed it," Pepper tells his students. To drive his point home, he stages a cook-out sometime during the 10-week program when he serves nothing but what the marine mammals are fed -- smelt, mackerel, and even squid.

Another lesson deals with the medical treatment of marine mammals. For instance, dolphins are periodically taken out of the water for physical examinations and innoculations. Handlers learn that a dolphin's skin is very tender and will cut easily if it is treated roughly. If their eyes bang against the sides of their pens dolphins can also be blinded.

At NUC there are eight floating dolphin pens just offshore, each is 20 feet square and 10 feet deep. Trainers stand on boardwalks at the edge of the pens.

For MOP students who complete Pepper's course, this may very well become a familiar environment. So far, some 20 MOP people have worked with Pepper on an intern basis. Eleven students are currently working part-time at NUC to support the ongoing research activities. Maintaining and feeding the mammals, training them, and taking care of the facilities are a few of their chores.

One of the research projects currently under way is to determine to what extent loss of learning found in trained laboratory rats applies to dolphins. NUC scientists are also trying to determine what circumstances cause stress in a dolphin. It is already known that dolphins are highly sensitive to change, even to something as minor as the change in color of the food bucket being used.

Furthermore, they are trying to answer basic physiological questions, such as heart rate, body temperature, and vitamin requirements of a healthy dolphin.

paul siri: *The first thing you have to do is train them not to bite.*

"I clean up after the animals a lot on weekends. Big animals require a lot of care," Paul Siri admitted candidly. But that hasn't kept him from taking marine mammal training seriously and wanting a career of research in that field.

Paul works 15 hours a week for Dr. G.C. Whittow at the Pacific Biomedical Research Center and 15 hours a week at NUC under Dr. Ross Pepper. At the same time, he is finishing up his fifth year of studies for a degree in zoology. "I needed more background in physiology before I could work with Dr. Whittow," he said. (Paul has already finished his bachelor's degree in experimental psychology.)

Dr. Whittow, a physiologist, studies temperature regulation,

Paul explained, and he uses sea lions because, being marine mammals, they are exposed to a wide range of temperatures -- heat stress on land and cold stress in water.

Whittow is particularly concerned with thermal regulation because he believes that the animal's behavior is largely responsible for controlling temperature. One of their important discoveries, according to Paul, is that, contrary to other mammals, sea lions neither pant nor sweat.

Unlike most MOP students, Paul was already involved enough in his subject to approach Dr. Whittow on his own and ask to work with him. "The job is kind of a unique experience," he said. He works six days a week training the sea lions and also fabricating experimental equipment.

A large part of the job of training is getting the sea lions adapted to wearing harnesses and telemetry equipment so that the animals can be monitored in a natural situation.

Among the things Paul has learned about sea lions is that they don't live up to their lovable stereotype. "The first thing you have to do is train them not to bite. In their natural environment, sea lions are very vicious and the competition is rough. The strongest bull gets the most females and things like that," he said.

A glossy sea lion obediently follows Paul Siri's commands. She is being trained to tolerate monitoring equipment so that her physiological reactions can be measured in a natural environment.

Once the animal is captured it takes about three months before it feels really comfortable, Paul explained. Even then, some of the sea lions can be temperamental. Occasionally, there is a slow learner in the crowd, such as the big bull sea lion presently at PBRC.

As far as what this will mean to his future, Paul said, "One hundred twenty-five percent of every week is devoted to learning about animals. You can't beat a situation like that for gaining valuable experience." Since he plans to go to graduate school and continue his physiology studies, Paul finds his MOP experience to be meaningful.

dr. john t. o'brien: *This group worked diligently and it wasn't easy.*

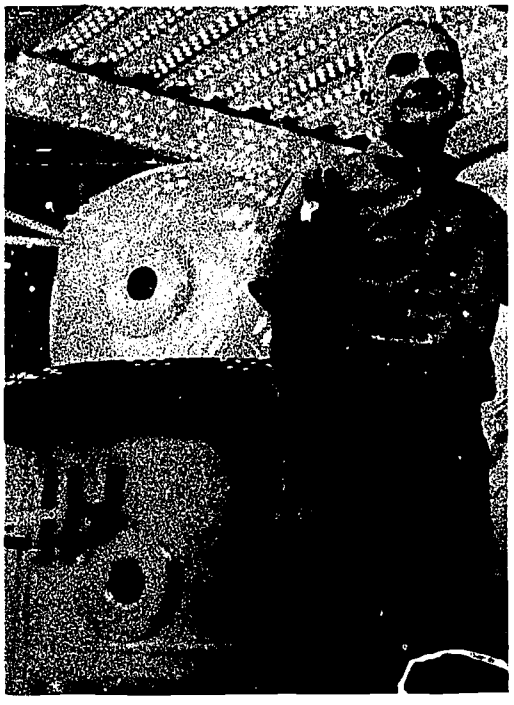
Dr. John T. O'Brien, Director of J.K.K. Look Laboratory, had a few terse, but pertinent comments to make about MOP

students who have worked at his facility. First of all, he wanted it clarified that his laboratory only supplies the services for students. It does not pay them. Nor does he directly supervise MOP students.

However, Dr. O'Brien was very impressed with the group of MOP students who worked under student leader, Rick Wilson, laying a four-inch diameter plastic pipe from the Pacific Biomedical Research Center to a point some 2,000 feet offshore. The purpose of this project was to pipe fresh sea water to marine life in tanks at PBRC.

"As far as I know, this group of boys and one girl worked diligently and it wasn't easy. There are highly disturbed wave conditions in the open ocean," O'Brien said. "It was a difficult job."

"If all the MOP students are as good as these, it is a worthwhile Program," he added.



Dr. John T. O'Brien, shown here with the deep sea rescue mini-bell (left) and the hyperbaric facility at Look Laboratory (right), has helped a number of MOP students gain experinece in ocean-engineering projects.

keith nishioka: *You encounter the problems more vividly in real life.*

J.K.K. Look Laboratory is one place where students learn that not every place of scientific research is sterile white with wall-to-wall test tubes.

Keith Nishioka, an undergraduate student in geology and geophysics, went to work at Look Lab about a year ago, and one of the skilled trades he

picked up is welding. "You do all kinds of odds and ends," Keith said. "I helped build the VBLD, Variable Buoyancy Lifting Device, that is constructed of two 55-gallon steel drums. It can lift objects off the ocean floor from 150 feet or so."

Welding is one of the practical skills that Keith Nishioka acquired through his work with J.K.K. Look Laboratory. He is repairing part of an underwater sand recovery system that he helped construct.

Keith's job was to weld the pieces together and fabricate the valves -- "All manual labor and some thought."

He saw more action when he helped Fred M. Casciano, a graduate student in the Engineering Department of the University, build his SSRS, a Submarine Sand Recovery System. The device blasts itself into the ocean floor and sucks up sand. That sand is discharged from the pump system onto the beach or barge.

"It's a lot cheaper and simpler than the way it is usually done with an arm that scratches the surface," Keith said knowledgeably. "The SSRS takes only two divers to install it. Afterwards, only one crew member has to be aboard a boat to watch the pumps, day and night."

Commenting on this experience, Keith said, "It showed me what an engineer does. It's very interesting. In a book, you don't find the problems you will encounter. You encounter the problems more vividly in real life, especially when your project blows up."

His experience with a "blow-up" happened while working with another diver installing the sand recovery device. "We were blasting into the sand," he recalled, "and one of the couplings broke on the discharge section of a six-inch diameter hose. That thing whipped around like a huge snake. It was in about 40 feet of water. It went up to the surface and came down again. Luckily no one was hurt."

"It can be exciting at times," Keith admitted.

In addition to "building things" that Keith likes, his job allows him to practice a little geology -- sifting and measuring the particle sizes of dredged sand samples.

Looking back on a job he had two years ago, selling carpetting and "looking busy" in a local department store, Keith considers himself very

lucky. "Here you have new problems. You are introduced to a lot of new things. It's interesting," he said.

robert wong & bill thomas: *For experience you can't beat it.*

Two MOP students worked as legislative interns who monitored any hearings that have to do with marine affairs during the just ended session of the Seventh Legislature of the State of Hawaii. The fact that these interns devoted between ten and twelve hours a week to a job that paid only in experience did not dampen their enthusiasm.

Intern Robert Wong, a sophomore ocean engineering major, stressed the fact that he values being exposed to the actual legislative process. "For experience you can't beat it," he insisted.

Wong and Bill Thomas (the latter is a senior majoring in zoology) worked directly under J. Thomas Stuart, legislative representative of the Office of Marine Affairs Coordinator. They had weekly meetings with Stuart who provided guidance whenever necessary.

The interns began working at the beginning of March 1973. Their first task was to do in-

The Hawaii State Capitol building in the background is where MOP interns attend legislative sessions on behalf of the State Marine Affairs Coordinator's Office. J. Thomas Stuart, left, is Dr. Craven's legislative assistant and supervisor for Robert Wong, center, and Bill Thomas, right, 1973 session interns.

tensive reading on the subjects that would be coming before the legislature in that session: water quality, sewage treatment, aquaculture using sewage, and the recovery of manganese nodules from the ocean floor.

Bill Thomas, for one, is an enthusiastic fan of the Marine Option Program. His first project, the Mokapu Outfall Baseline Study, gave him a strong dose of success. During the study he acquired his ocean skill of identifying invertebrates.

As a result of the project, he has decided to stay at the University for another year, with hopes that a follow-up project on the Mokapu study will be funded. The whole object of the first project was to determine the size of the invertebrate and vertebrate populations before the installation of a sewage outfall in that area. The follow-up would measure any after effects.

In December 1972, Bill and two other MOP students, Carrie Matsuzaki and Robert Western, were sent to Washington, D.C., by the Program to hand in a report on the Mokapu Outfall Baseline Study. "Stanford and Harvard did similar studies," Bill found, "but theirs didn't turn our as well. Stanford had to contend with the surging waters on the California coast and Harvard hadn't budgeted their money very well, so they ran out of cash before they could complete their project." Bill added proudly that his group had $1,000 left over.

The fact that the head of the National Science Foundation in Washington, D.C., which had funded the study, "was very enthusiastic" made the visit that much more enjoyable.

Although Robert Wong hasn't been offered a glamorous, free trip to Washington, D.C., he is just as motivated as Bill. "I think the Marine Option Program is really, really good," he said. "It gives the ordinary student a chance to gain a marine skill."

Before becoming a legislative intern, Bill worked at Look Laboratory as a technician's apprentice and helped construct a sand dredge.

When he gets his ocean engineering degree, he hopes "that the ocean field will be more developed." But he is realistic. "If after one year there is no job, I'll join the Peace Corps," he said.

dr. john e. bardach: *The Marine Option Program represents one of those interesting and good ideas.*

As Director of the Hawaii Institute of Marine Biology, Dr. John E. Bardach sees many of the MOP students who work at Coconut Island. He has also gotten himself involved in MOP by volunteering to teach the interdisciplinary studies course, Living Wealth of the Oceans.

"The Marine Option Program represents one of those interesting and good ideas that

should be nurtured and directed, not as a thing in itself, but because it is a good thing to do," Bardach said. "If it is done right it can backstop research-oriented activities in an important way."

Dr. John Bardach, Director of the Hawaii Institute of Marine Biology, finds time to teach an interdisciplinary ocean course designed for MOP students called Living Wealth of the Oceans.

As an example, Bardach cited the Mokapu monitoring project which was "integrated into an important study."

The only danger that the HIMB director sees in MOP is that it creates such a stir "that that's where people think the action is." He would rather see it taken as a whole, integrated into the "true marine affairs enterprises of the State of Hawaii." Major marine research must continue to be funded, he emphasized.

Instead of keeping Coconut Island as an exclusive retreat for accomplished scientists, Bardach encourages MOP students to seek jobs there. If they can't be hired they can work as volunteers, he said.

Some of the projects involving MOP help on Coconut Island include aquaculture nutrition studies, research into thermal pollution and associated stresses to coral ecosystems and octopus culture. "It is easy to integrate undergraduate students into these areas," Bardach said. "Where it is more difficult is in ocean engineering, economics, and law. In those fields, there is a need for more skills than the average Marine Option student has."

Dr. Bardach's own specialty is the physiological ecology of fishes, a subject on which he has written numerous books and articles. He doesn't hesitate to mention that he has both a national and international reputation. However, he is eager to stress the fact that he considered Hawaii's oceans rich enough in potential to interest him.

nancy preston, marilyn jewett, & jim drabble: *It's exhilarating being out on a boat.*

Nancy Preston and Marilyn Jewett went aboard the National Oceanographic and Atmospheric research vessel, U.S.S. RAINIER,

with the understanding that "they would be treated like one of the guys." Their male counterpart Jim Drabble boarded the RAINIER's sister ship the FAIRWEATHER on a later cruise.

On board the NOAA Research Vessel, FAIRWEATHER, Jim Drabble worked with ship's personnel in hydrographic studies of the Kona coast. He spent three weeks aboard.

The girls were, in fact, almost rejected because there were no separate facilities, but they slept in sick bay and insisted that they didn't mind. They left in October 1972 and were on the ship for one week, long enough to do basic survey work, charting, and calibration on a computer. Jim Drabble, a psychology major, followed in their footsteps aboard the FAIRWEATHER in April 1973.

"Marilyn and I really enjoyed it," Nancy said. "That ship was just fantastic. All the equipment must be the newest and the best."

"We spent a couple of days on a hydro-launch, mapping the bottom. We learned to read a hydrograph and shoot angles with a sextant. I did a little with a computer, not enough to do any damage if I messed up."

Nancy admitted that they worked hard the whole week. Her only regret was that by the time she began to know what she was doing, it was time to go home. "On the last day, I almost felt like part of the crew. I was doing my job by myself," she said.

Nancy is a young widow with two children who has decided to go back to school to study archeology, and "go to Mexico to dig up old ruins." She got into the Marine Option Program, she explained, not for the certificate, but because "it sounded like an ideal opportunity to get into things in Hawaii that I wouldn't get into otherwise." She had always been interested in porpoises and managed to get herself an internship training them.

"I really like that. Porpoises are amazing. They're almost like people. They have moods," she said.

Nancy also took sailing and diving classes which she claims she might never have done otherwise. "It's amazing the doors that open. The people running the Blue Water Lab approached me about being a cruise instructor and I"ll probably do it."

"It's exhilarating being out on a boat and it's good for the high school students. It's kind of hard to get these things across in a classroom. It seems to add what classroom-oriented education lacks. It is a way of getting involved."

Nancy's own future has been affected by the Program. Now she's thinking about the possibility of a career in underwater archeology. "Last summer I went to Europe and saw an old diving magazine," she said. "In Plymouth, England, there is a diving school where they teach underwater archeology. I'm thinking of going back to Europe this summer. You can go to the school as long as you want -- a week, a month. I still have the address."

alan hong: *There is a big emphasis on oceanography, but most high school science teachers don't have the expertise to teach it.*

Once the Marine Option Program was really in motion at the University level, local high school students and teachers began calling the MOP office.

They had questions about marine subjects. They wanted help in organizing their own ocean-oriented projects.

"There is a big emphasis on oceanography, but most high school science teachers don't have the expertise to teach it," Alan Hong explains. "The kids surf and swim, so they are interested in the ocean. This has caused pressures to teach marine material."

MOP's solution was to organize high school students into an island-wide marine science club, Kamalii O Kai, a Hawaiian phrase meaning "Children of the Sea." Expertise was supplied by advisors from MOP: Alan Hong, a senior engineering student, Donna Noborikawa, and JoAnn Kushima.

"We started by writing to the principals of each school and asking them to send a representative to the University for the group," Alan said. Some 17 representatives came to the initial meeting. Since then almost all of the high schools on Oahu have formed their own branch of "Kam Kai."

Through the generosity of the Hawaii Institute of Geophysics, the TERITU was made available for cruises when HIG scientists were not using the ship. "We have a list of schools and students interested," Alan said. "When we have an opening we call them and we run two cruises a day, one at 8:00 a.m. and one at 1:00 p.m."

The Hanauma Bay underwater tour was also incorporated into the Kamalii O Kai experience. Now the high schoolers are planning to train students from each school to give the tour to their own classmates. Guides will have to have a thorough knowl dge of the coral formations in the Bay before they can conduct tours. They will also learn names and habits of the indigenous fishes.

Some of the participating high schools have started their own projects. For instance, Pearl City High School students built several saltwater aquariums. "They have an aquarium that holds nearly 100 gallons," Alan said, "and a couple of others that hold about 20 gallons each. The teacher takes them out to Maile to collect specimens."

When the topic of the annual science camp for high school students came up this year, it was agreed that the theme of the event should be oceanography, since there was so much interest in that subject. A representative from each school attended once-a-week strategy sessions for several months to work out an agenda for the three-day camp-out at Camp Kokokahi.

High school students learn about the sea cucumber under the tutorship of MOP students participating in the high school orientation program.

Alan Hong arranged for the 120 campers to visit the marine science facilities on Coconut Island and at Hanauma Bay. Doug Pendleton gave a talk about the Blue Water Floating Lab and Charlie Rolison presented a slide show and talk about Hanauma Bay. Charlie also conducted guided tours.

Dr. John Craven discussed the transportation situation in Hawaii. The basic problem, he said, is that the state has become too car-oriented. With a marine transportation system, Hawaii could probably solve its traffic woes and over-crowding.

Students got their feet wet, too. They measured the salinity of Kaneohe Bay, took productivity counts and water nutrient measurements -- things they couldn't do surfing or snorkeling.

"It went a lot smoother than I expected," Alan said after the camp was over. "I'm really proud of the way the students pulled it off."

randy chau: *We plan to begin tagging turtles soon to determine the population.*

The first MOP students to work with the aquaculture research group on Coconut Island is still there after a year and a half. As a marketing major, Randy Chau has had valuable skills to offer the staff which is primarily science-oriented.

Saving the turtle is a major concern to George Balazs, researcher at the Hawaii Institute of Marine Biology. His research, extensive in scope, has been aided by MOP students.

Under Dr. Philip Helfrich, Chau helped research the marketing potentials of *Artemia salina*, brine shrimp, the food widely used for aquaculture and pet aquariums.

Chau is currently involved in turtle research under George Balazs, to learn more about the life history of the green sea turtle as it relates to feeding grounds around the islands. Chau has also gathered information from the State Division of Fish and Game on which to base turtle conservation legislation.

Before Balazs began his turtle research, little was known about them except that they were dwindling in number.

"We plan to begin tagging turtles soon to determine the population," Chau said. "We're going to the island of Hawaii aboard the VALIANT MAID in late May."

glenn sato: *They catch all kinds of diseases and fungi. They bite each other. They fight a lot.*

Glenn Sato, a senior in marine biology and a MOP student, wanted "some experience in other marine-related fields," so he went to George Balazs and Bob Brick on the research staff at Coconut Island and volunteered his time.

"For three or four months, I went there on my own and worked about four hours every Saturday," Glenn said. "Then they gave me $1.60 an hour to help pay for gasoline. Other students were going over the same way. They have a lot of volunteer help and they really need it. Any help is really appreciated."

His first two tasks were to cut up eels for food and to segregate fish that were caught in trawl nets. He also cleaned lobster and octopus tanks. Then, when Balazs started to ship turtle eggs to Coconut Island to try to hatch them there, Glenn "had to dig holes in the coral and put screens around them so the mongooses and the dogs wouldn't get the buried eggs."

The peaceful, picture-book scenery on Coconut Island belies the constant level of research activity conducted on it. Projects encompass thermal red pollution and aquacultural research on octopus, baitfish, shrimp, molluscs, and prawn.

"When Balazs' efforts to hatch turtle eggs in Kaneohe Bay did not produce sufficient numbers for experimentation, Glenn started tending turtles in tanks kept on the Manoa campus. One-day old hatchlings were collected and transported from the French Frigate Shoals. "We feed them, clean their tanks, treat them," Glenn said. "They catch all kinds of diseases and fungi. They bite each other. They fight a lot."

"It is really fun getting the feel of it," Glenn said. Among the things that he has learned is that he definitely enjoys field work better than "being stuck in a lab."

He has taken a scuba diving course and has found that, even though he passed, it was not an easy course.

"The Marine Option Program offers a lot for anyone who is really interested," Glenn said. "I don't think you even have to be marine-oriented. If you want to find out about something, they send you out and you get first-hand experience."

clark lewis & richard fernandez: *We'll be fiberglassing water tanks, pouring cement, and building fish traps at first.*

On a jutting peninsula of Coconut Island, there is a row of outdoor tanks surrounded by a maze of plastic pipes and hoses. All of the hoses seem to emerge from the shed-like thermal pollution study center. Inside are Ric Guinther and Gerry Key, two doctoral candidates who recently hired a couple of MOP students to work on this project.

"It is not all scientific [illegible]" Ric warned Clark Lewis and Richard Fernandez. "Sorting samples is very boring, tedious work. It is something most people don't get at the college level, but everyone should be exposed to it."

Both Clark, a zoology major, and Richard, a psychology major, looked dubious. But the following week, they reported for work. And since their arrival, a new network of pipes and a low wooden tower have been added. The pair has also been seen in wet suits measuring the water depths and con-

structing tanks on the reef near the facility.

"We'll be fiberglassing water tanks, pouring cement, and building fish traps at first," said Clark and Richard. "Later we'll get into field study and lab work."

Funding for the project will continue for another year through a new grant of the Environmental Protection Agency.

MOP students poured cement slabs for the container they are anchoring on the reef. It will be used as part of an experiment designed to measure thermal pollution factors.

joann kushima: *I have a special interest in fish.*

JoAnn Kushima helps Dr. John Miller with his fish larvae study at Coconut Island. "I have a special interest in fish and probably will go into taxonomy," JoAnn said.

"It started last summer when a group of undergraduates got together for the Mokapu Outfall Baseline Study. I didn't know which fish was which. They had classes for us and an instructor."

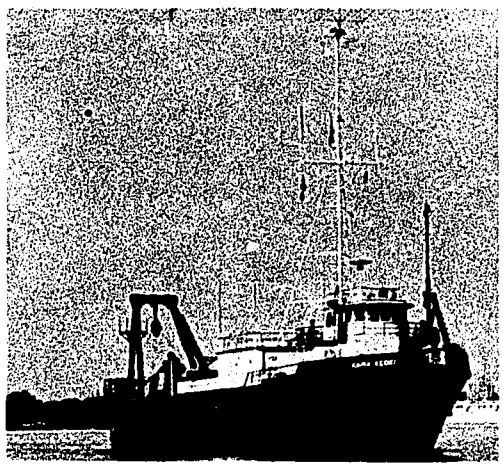
She was one of the 15 students who participated in the research. When it was over, she took a course in advanced ichthyology and will graduate in December as a zoology major. Before that, she was interested in journalism and had been the editor for the MOP *Hotline*.

JoAnn Kushima works for Dr. John Miller at the Hawaii Institute of Marine Biology to fulfill her MOP internship. As an undergraduate she is assisting in a major larval fish study.

waymond kwock: *Scientists believe that Fiji may be rotating and moving.*

Waymond Kwock fulfilled his MOP internship on a three-month cruise of the South Pacific aboard the oceanographic research vessel KANA KEOKI. The ship sailed along the southwest Pacific doing ocean bottom surveys.

As part of the paid scientific crew, Waymond explained, "You stand watches to make sure all our recorders and instruments are in working order." He also worked with the "eels," a series of hydrophones which register sounds transmitted through the water to produce a profile of the ocean floor.



The KANA KEOKI serves as a training facility for MOP students.

"A lot of the projects the scientists were working on were interesting," Waymond said. "They did an initial survey for the Scripps Institution of Oceanography ship, the GLOMAR CHALLENGER, which plans to take core samples from the ocean floor." The GLOMAR CHALLENGER is a unique ship, he explained, in that it is capable of remaining almost motionless on the surface of the ocean while these samples are taken.

"Scientists believe that Fiji may be rotating and moving," he added. Another question they are interested in researching is whether or not the remarkably flat Lord Howe Plateau near New Zealand may actually be a submerged continent.

In order to take this cruise, Waymond had to skip a semester of school, but he felt it was well worth the experience. From the time he was five years old, when he and his family arrived from China, he had never been away from Hawaii.

A senior physics major, who is thinking of studying oceanography in graduate school, Waymond is grateful for the opportunity MOP gave him to get first hand marine science experience.

"MOP is a great Program for undergrads," Waymond said. "I don't think there is any other program that gives undergrads a chance to get involved in oceanography. It is a doorway for people who are interested."

kelvin char: *One of the biggest advantages was that it put me into the scientific community.*

Kelvin Char is one of the rare undergraduate students who has been able to take advantage of a myriad of opportunities available to him. One of them has been to write, as his senior honors thesis, a photographic key and handbook on Hawaiian algae.

Kelvin collected many of his algae samples in Kaneohe Bay and used the Hawaii Institute of Marine Biology's excellent scientific library located on Coconut Island in the southern portion of the Bay.

When MOP began, Kelvin was already a sophomore "looking for more than a traditionally structured education." As he explained, even before joining

As budding student scientist, and later as an administrator in the Program, Kelvin Char has added many dimensions to his future marine-related career.

MOP, he spent a good deal of his time in the ocean, so the Program was a natural one for him.

Both John Craven and Barry Hill interviewed Kelvin and selected him to work as an intern under Dr. Keith Chave, Chairman of the Department of Oceanography.

At the time, Dr. Chave was studying the economic viability of transplanted corals. With his direction, Kelvin and Dr. James Maragos, then a Ph.D. candidate, collected data and transplanted coral, working both in the laboratory and in the field.

"It was a very enjoyable tenure. I received practical field experinece," Kelvin said. "It broadened what I had presupposed about research. One of the biggest advantages was that it put me into the scientific community, meeting project investigators, etc."

After internship, Kelvin worked with the Mokapu Outfall Baseline Study as leader of the vertebrate study group in the summer of 1972.

In the fall of 1972, Kelvin said, "Barry asked me if I wanted to work with him as assistant student director of MOP." In that position, he has been one of the major student coordinators for the Program.

"I plan to specialize in international maritime law, marine resources, and coastal zone management," he said. "This is a relatively new branch of law and deals with the exploitation of resources in undefined areas of the ocean."

After leaving MOP, Kelvin said, "I expect to see this Program continue to expand and ultimately achieve full growth. The reason I am optimistic is that the State of Hawaii will have to take a new posture as far as marine-oriented research and education is concerned. Marine resources really haven't been looked into in this State and it is foolish considering its unique geographical location."

"With the help of the Marine Option Program, Kelvin expects to see a group of people "sensitized" to the ocean who will work to develop and conserve its ocean resources. In the meantime, he said, MOP has "not neglected the present generation. We are trying to educate our legislators so that the community may benefit through enlightened legislation, sympathetic to Hawaii's tradition in the sea."

robert ho: *All the natives came out to greet us.*

Another MOP student, Robert Ho, joined the crew of the KANA KEOKI in Fiji. He flew in from Honolulu and stayed on board until November.

As a crew member, Bob participated in heat flow studies and depth soundings. "We plotted a zig-zag course. Right along the perimeter of the Fiji

plateau where there is twisting, the sediment temperature is higher," he said.

"The Fiji plateau is rotating in a counterclockwise direction and it has risen above the ocean bottom," Bob said. "The theory is that the plateau is unscrewing like a lid on a jar and that the thing may blow off."

As part of his MOP internship, he authored an extensive report of his activities on the KANA KEOKI and submitted it with sketches and pictures of various instruments and a floor plan of the ship. He even brought back samples of manganese nodules that were discovered.

One experience that he wasn't able to diagram, but that he is certain not to forget, is his trip to Cherry Island. "We wanted to find out if it was created by upcrusting or volcanic activity. If the Cherry Island samples matched in composition with the samples from Vitiesse Trench, the second deepest trench which has been found to date, then Cherry Island would be the result of upcrusting, not volcanic activity," Bob said.

There were ten in the shore party and Bob was one of them. They landed amid fairly calm two-foot waves. "All the natives came out to greet us with canoes," he said.

The hospitality didn't end there. After the scientists were welcomed and had gathered their samples, they went back to their landing boat and found that the waves were fifteen feet high. Story-book style, the natives invited the scientists into their huts where they were treated like royalty for the night. "I slept in a thatched hut," Bob recalled, "and the man of the house fanned me all night. That is really what you call hospitality. I later found out that this had been done for every one of us."

Although none of the members of the shore party realized it, while they were sleeping, the women of the village were preparing a feast for their breakfast. "It was a luau feast with Polynesian food -- taro, fish, dog -- spread out on coconut leaves."

Unfortunately, the waves subsided and the small boat was able to leave that afternoon.

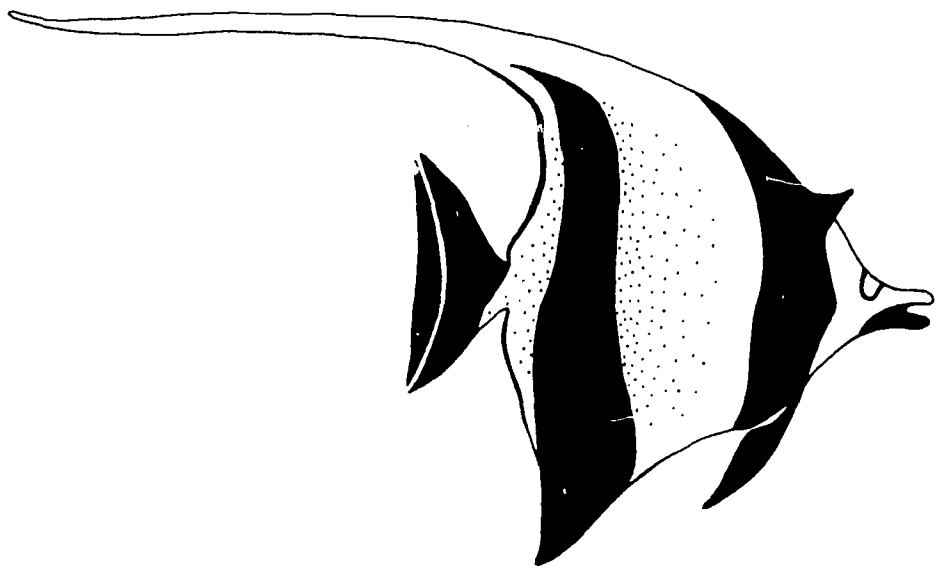
From Fiji, the KANA KEOKI sailed to Tahiti. "It was around Christmas time and they wanted me to stay on board for the Peruvian leg of the trip. They were going to do quarter ton and half ton explosions and seismic readings, but I wanted to be home with my family for Christmas," he said.

Bob came back to Hawaii. He had much time for pondering his future while aboard ship, and decided that pure ocean science was not for him. He changed his career goal and switched his major from ocean engineering to a triple business major of foreign trade, management, and marketing.

"I wanted to be on the first team to build a city undersea." Now he has decided to leave that project to other scientists. "We have good scientists," he said, "but I don't think we have good managers who can efficiently allocate our

limited resources, so I switched. If you have good businessmen and managers you can do more to benefit all mankind."

Instead of competing for research grants, Bob would like to see all scientists working to solve problems together as a team.



acknowledgements

A report of any program can only reflect its highlights. And this report is no exception. Only a few of the faculty and students who participate in the Marine Option Program have been included in this report to illustrate part of the mainstream of the Program. But, as in any cooperative venture, the forward momentum requires the devotion and dedication of everyone involved. To the many, many students and faculty members who are not mentioned here by name, Marine Option Program owes much.

In addition, we acknowledge the valuable aid of Rose Pfund, Karen Tanoue, and Loretta and Whitney Robinson in making this report possible.

* * * * * *

Photo credits:

Hawaii State Archives:	pp. 2, 3, and 4-5.
Whitney Robinson:	pp. ii-1, 6-7, 9, 11, 12, 13, 14, 17, 20, 30, 32, 34, 35, 37, 38, 40, 41, 42, 43, and 44 (top).
Warren Roll:	p. 23
Howard Pennington:	p. 44 (bottom)

MARINE OPTION PROGRAM

OBJECTIVES

The Program has three major objectives:

1. To provide an opportunity for any undergraduate student at the University of Hawaii or any of its Community Colleges, from any academic discipline, to acquire a marine orientation during his or her four-year period of study.

2. To enhance the student's marine orientation and provide relevance for his academic studies through involvement in practical skill-acquisition programs.

3. To propose and implement special seminars and interdisciplinary courses designed to acquaint the undergraduate student with the broad bases and many facets of research and development in the marine field.

METHODS OF OPERATION

The student must complete two requirements for successful completion of the Program, one academic, and the other, practical.

By the time of graduation, the student must complete the following minimum ACADEMIC core of 12 hours' study in marine and marine-related courses:

1. Basic Oceanography (Ocean 201) or equivalent.

2. One three-hour marine interdisciplinary course.

3. Two three-hour courses, or six hours in directed reading/research, in the student's major field, having a marine orientation.

Most academic disciplines at the University have courses that are in some way marine-related. A list of these has been compiled from which the students may choose. Several marine interdisciplinary courses have been created especially for the Program (see PROGRESS section). Advanced undergraduates are encouraged to pursue independent study and research for credit through liaison with their departmental advisors.

The second requirement for completion of the Program is the demonstration by the student that he has acquired a PRACTICAL, MARINE SKILL. "Marine skill" is defined as a level of proficiency attained in a spe-

cial area, through repetitive exposure to and practice of a marine-related technique.

Some students, upon entering the Program, may already have a marine skill. They may be proficient underwater photographers, surfers, or sailers. Others may have experience in research in marine biology or ocean engineering. In these cases, if the student is judged by his sponsor or supervisor to possess a marine skill, he need fulfill only the academic requirements to complete the Program.

Students who need to acquire a marine skill can do so through the Program. Many students volunteer their time to obtain the skill; others are paid a small stipend from a marine internship fund established under the direction of the Office of Marine Programs. Student help funds included in current marine research projects under way at the University provide support for a number of Marine Option students (see p. 57 ff. for list of sponsors).

Upon completion of the Program requirements, the student is awarded a certificate by the Dean of Marine Programs attesting to the student's competence in a specific marine activity.

PROGRESS

The Program was initiated in March 1971 with an innovations grant from the University of $8,000. Sea Grant support became available in July of that year. From an initial enrollment of 75 students, the Program has expanded to include 300 students from disciplines ranging from interior design to zoology and English.

Academic Development

All students enrolled in the Program receive academic advising. A detailed list of all marine-related courses offered at the University has been compiled. Four marine interdisciplinary courses have been proposed and implemented with more anticipated for future semesters. These are: "Sea and Society," "Living Wealth of the Oceans," "Economics of Sea Systems," and "Man, the Ocean, and the Environmental Crisis."

To meet the need to maintain frequent communication with the students, a weekly news bulletin, the *Hotline*, was initiated in July 1971. In addition, a bimonthly newsletter, edited and published by Marine Option students and aimed at stimulating more student participation and interaction went into publication in March 1973.

Since student participants come from almost all disciplines at the University, it is necessary to promote liaison with faculty and staff for advising purposes. A list of faculty from several departments has been compiled to advise the Marine Option students.

Marine Skill Development

Of the 300 students in the Program, approximately 160 have been aided in developing a marine skill. Sixty-five students have been or are now involved in long-term (six months or more) skill acquisition programs. The students are working under the sponsorship of various university and private institutions.

Independent research, including student-originated and student-led projects in underwater trail development, succession studies on an artificial reef with the State Department of Land and Natural Resources (due to begin summer 1973 under a $17,000 NSF grant), and an ecological baseline survey of an Oahu coastal zone area (completed by 15 students summer 1972 under a $24,000 NSF grant), is an integral part of the Program. Also, twelve students constructed an underwater pipeline for the new Pacific Biomedical Research Facility at Kewalo Basin (supported by $10,000 in State funds).

Many other students are acquiring marine skills in aquaculture at the Hawaii Institute of Marine Biology (supported by Sea Grant), thermal pollution of reef areas (NSF supported), marine mammal training at the Naval Undersea Center (under a Navy contract with the University of $25,000), undersea sand mining at the J.K.K. Look Laboratory of Ocean Engineering (Sea Grant supported), oceanographic technician training (aboard University research vessels and NOAA survey ships), as well as in ocean law, marine mass transit, and floating city design, which are all Sea Grant supported projects. (See APPENDIX for complete list.)

Many students have been trained in basic and advanced scuba, underwater photography, sailing, sport fishing, small-boat handling, and aquaria management. These are continuous offerings of the Program.

Extension of the Program

A fully operational branch of the Program now exists on the Hilo campus of the University with 50 student participants. Students from Leeward, Windward, and Honolulu Community Colleges participate through the Program at the Manoa campus on Oahu. Maui and Kauai Community Colleges have expressed interest in forming program branches on their campuses.

As an extension of the Hilo campus Program, a marine facility is now being developed at Kawaihae on the island of Hawaii under the joint sponsorship of MOP, the Hawaii Institute of Geophysics, and interested members from the community. This facility -- the Marine Option Center -- is being used by the students as a staging and laboratory research area for projects in aquaculture, aquarium management, diving, and marine life tours.

In efforts to acquaint students and faculty of community colleges, high schools, and the general public with methods of basic oceanographic research, the Program, in cooperation with the Hawaii Institute of

Geophysics, has made the R/V TERITU, the University's 96-foot research vessel, available for a series of half day instructional cruises. Over 1,100 students from Oahu, Maui, Molokai, and Hawaii have participated in this "on'board" orientation program.

During the spring semester of 1972, students in the Marine Option Program and high school teachers and students formed a high school orientation group called "Kamalii O Kai," Children of the Sea. The function of this group is to serve as an impetus in the development of marine-oriented programs and activities at the high school level. Marine Option students who are interested in careers in marine education have provided vital leadership to this program.

Additional Activities

Through the cooperation of the National Oceanic and Atmospheric Administration, the Program has been able to support additional ship-board orientation programs for students. Eight students have spent up to three weeks aboard NOAA ships to observe and participate in bathymetric surveys, navigational exercises, charting, and station monitoring. Marine Option students will participate in long cruises aboard the largest NOAA ship, OCEANOGRAPHER, during 1974.

A diving club, the University Aquanauts, was formed under MOP sponsorship in 1972. The chief purpose of this club is to provide additional supervised diving experience after the student has received his basic scuba certification. Members participate in bimonthly meetings, hold weekly recreational dives, have helped in the construction of an underwater pipeline, and, most recently, have proposed to sponsor an underwater film festival for elementary and high school students.

Marine Careers

Although the chief objective of the Program is to provide undergraduates with a marine orientation, not technician or career-patterned training, several Marine Option students are pursuing graduate marine training or have obtained jobs in the marine field. One student has joined VISTA and is working on a dory fishery project in American Samoa. Two MOP students obtained skills in raising giant Malaysian prawn. One will be in charge of prawn research in Micronesia while serving as a Peace Corps volunteer; the other student will shortly be joining the staff of Global Marine as a trainee in a prawn-raising project on Oahu.

A student who interned in a bait fish genetics project is now working full-time in the Department of Physiology at the University of Hawaii on similar studies. Having gained skills in coastal marine life monitoring under Sea Grant's Quality of Coastal Waters project, another MOP student will continue on the project full-time as a junior researcher next fall. An electrical engineering student who worked at the Naval Undersea Center in marine mammal behavior projects as a MOP student is now a jurior officer trainee with the Naval Undersea Center in San Diego. A zoology student who also worked at the Center is doing graduate work in animal behavior at Stanford University. Future Program graduates plan to pursue graduate training in law, aquaculture, economics, and marine science.

FISCAL REPORT

This report represents an attempt at placing a dollar valuation on the activities undertaken by students in the Marine Option Program to gain marine skills. The report covers all expenditures from the inception of the Program on March 1, 1971, to projected expenditures by August 31, 1973.

The range of activities undertaken by the students reflects the comprehensive nature of the Program. Every marine laboratory and institute under the control of the University of Hawaii and the Oceanic Institute have been involved directly in providing training for students in the Program.

Since it would be almost impossible to account for the extensive and generous consultation services provided by numerous faculty and researchers at the University of Hawaii, the Division of Fish and Game, the Department of Parks and Recreation, the County of Hawaii Department of Parks, the Cooperative Fishery Unit, and others, this has not been included in the report.

Many of the students in the Program, however, eager to attain marine skills, have contributed much volunteer effort to the development of student-proposed and student-led projects, and have also assisted various researchers at the University, at the Hawaii Institute of Marine Biology, at the Bishop Museum, and officials in the Department of Land and Natural Resources in their projects. The attempt was made, for purposes of this report, to account for such volunteer services in terms of dollars. Of necessity, the accuracy of these figures cannot be guaranteed.

Also not reflected in this report are the salaries paid to members of the faculty and outside consultants who have taught the many marine interdisciplinary courses that are required of the participant student for completion of the requirements of the Program. Fourteen faculty members contributed three to four hours of their time to introduce students in the Program to the various fields of activities in the marine-related sciences in the non-credit "Oceans I" seminar series conducted during the Fall of 1971. This is also not included.

Federal Sea Grant funds have contributed heavily toward the maintenance and development of the Marine Option Program. Though $8000 from the Innovations Fund of the University was made available for the Program's implementation in March of 1971, and President Harlan Cleveland provided $3000 from the University Foundation in August of 1971, no further State funds have been available other than travel and student help monies from the Marine Program General Fund. A few students have also received salaries under research projects supported by State funds.

The summary sheets that are attached divide the activities of the students into various categories. The category "Long-Term Marine Internships" refers to student marine activities having a minimum duration of four months. "Short-Term Marine Training Projects" refers to activities lasting from one or two days to two weeks. Marine activities primarily proposed and developed by students in the Program are placed in a cate-

gory "Student-Proposed and Student-Led Projects." Half-day or full-day single exposures to some aspect of marine activity are placed under the "Marine Experience Program." Other categories included are "Administrative Costs," "Equipment," and "Travel."

Funds in support of the Program have come from private marine in industry; federal funding agencies, Sea Grant, the National Science Foundation, Navy and others; the State of Hawaii; and from the students themselves. The total of funds expended is $182,052. This is broken down as follows:

	Amount	Percentage
Private Industry	$ 4,350	2.3
Federal other than Sea Grant	93,196	51.1
Sea Grant	34,524	19.3
State Funds	18,742	10.2
Value placed on volunteer student time Training paid for by students themselved Donations received	31,240	17.1
Total	$182,052	

Three particular items of interest must be pointed out in reference to these funds:

1) For every dollar expended by the State on this Program, $10.20 was received from other resources.

2) Of the $34,000 expended by Sea Grant on the Marine Option Program, $10,900 supported student interns working on various Sea Grant projects for which money was provided for undergraduate student assistance. This means that money expended by Sea Grant for undergraduate student assistants has led to the development of the Marine Option Program as well as providing student help for Sea Grant principal investigators. Of the remaining money expended by Sea Grant, the majority was used in support of the administration of the Program.

3) $31,000 or approximately 17.1% of the total monies available to the Program was provided by the students themselves who worked as volunteers for the administration and maintenance of student activities, or money spent by the students themselves to gain marine skills such as NAUI (scuba) training, sailing and small boat handling skills, aquarium management, curating and identification of marine algae, coral, and fish, and a one-week sailing trip to Kona, Hawaii, to perform a biological survey of Honaunau Bay, among others. This is an indication of the initiative shown by the students and their interest in the Marine Option Program.

FISCAL REPORT
covering period March 1, 1972 to August 31, 1973
LONG-TERM MARINE INTERNSHIPS

Private Industry	State	Federal other than Sea Grant (ONR, NSF, etc.)	Federal Sea Grant	Volunteer's Time	Sponsoring Institution	Activity	No. of Students
		$17,200			Navy	Marine mammal training Naval Undersea Research Center	15
	$1100	$1730.00		$150	HIG	Oceanographic training aboard R/V Kana Keoki, R/V Teritu	10
			$1900	$200	HIMB	Tuna Bait Resource Development Project	2
		$1000			HIMB	Coral reef substrate succession; aquacultural research	1
	$1000	$2176		$1000	HIMB	General work related to aquaculture; work at Eniwetok and Marshall Islands laboratories	2
			$400	$100	HIMB	Statistical reduction of data relating to aquacultural research	1
			$800	$400	HIMB	Assistants in aquacultural research	4
			$3000	$100	WRRC	Fish collection and identification; invertebrates, algae collection; Coastal water study	2
		$4250		$5650	HIMB	Dolphin behavioral research	10
				$1350	Oceanic Institute	Marine pollution, chemistry, and aquaculture research	3
			$1050		Sea Grant Office	Sea Grant Publications, reporting and editing	2
			$160	$1370	Bishop Museum	Curating and identification of fish, algae, coral and invertebrate collections	5
$600					Private Company	Assistant manager of McWayne's Marine Supply; selling marine products	1
	$450				Zoology Department	Assistant to researcher investigating the genetics of Nehu	1
			$1500		Marine Programs	Mapping, interviewing, and assisting in Coastal Zone Management Project	1

FISCAL REPORT

COVERING PERIOD MARCH 1, 1971 to August 31, 1973

LONG-TERM MARINE INTERNSHIPS

Private Industry	State	Federal other than Sea Grant (ONR, NSF, etc.)	Federal Sea Grant	Volunteer's Time	Sponsoring Institution	Activity	No. of Student
			$1500		Marine Programs	Assistants in Sea Grant Ocean Law Project	1
	$160				Marine Programs	Assistance on Floating City model construction and maintenance	2
				$400	Instructional Resources Service Cntr.	Trainees in underwater photography	2
$3000					Aquatics Hawaii, Inc.	Aquarium management training	1
			$850		Look Lab	Beach profile surveying and sand movement studies	2
			$500		Look Lab	Sand dredging; Sand Recovery Project	1
	$855				Department of Physiology	Diving physiology research	1
		$2240			East-West Cntr. Oceanic Inst. Fish and Game	Participants in Giant Prawn Culture Training Program	2
			$1955		Sea Grant College of Bus. Administration	Economic feasibility of ocean mass transit systems	3
			$250		Hilo College	Development of underwater trail at Mahukona, Hawaii	1
			$272		Hilo College	Baseline study of Kapoho coastal pond, Hawaii	1
			$1800		Hilo College	Kona Coast coastal ponds study	3

FISCAL REPORT
covering period March 1, 1971 to August 31, 1973
LONG-TERM MARINE INTERNSHIPS

Private Industry	State	Federal other than Sea Grant (ONR, NSF, etc.)	Federal Sea Grant	Volunteer's Time	Sponsoring Institution	Activity	No. of Students
			$1500		HIMB	Vertebrate behavioral research	3
			$1000		HIMB	Fish larval research	2
		$1000			HIMB	Octopus aquaculture	2
		$400			HIG	Statistical analysis Kaneohe Bay	1
		$1000			HIMB	Nutrition studies	2
		$750			Zoology Department	Coral reef investigation	2
				$1500	State Office Marine Affairs	Legislative internships	3

SHORT-TERM MARINE TRAINING PROJECTS

Private Industry	State	Federal other than Sea Grant (ONR, NSF, etc.)	Federal Sea Grant	Volunteer's Time/Paid for by Students	Sponsoring Institution	Activity	No. of Students
		$200		$400	HIG	Oceanographic technician training aboard R/V Teritu; participants in on-going research programs	9
			$200	$320	Look Lab	Sand inventory; extent of beach erosion on Maui and Kauai	4
		$400			HIMB	Marshall Islands; biostatus determination, fish-tagging, and census taking	1
				$1000	University of Tokyo	Trip to Japan; viewing of fish and algae aquaculture and library research	2
	$175			$2000	YMCA Marine Programs	Kona sailing trek; biological survey of Honaunau Bay, Hawaii	30
				$200	Coast Guard Auxiliary	Small boat handling and piloting course	40
	$500			$1750	Bureau of Student Act. Department of Physical Ed. Marine Programs	Sailing instruction	70
				$3500	Marine Programs	Basic NAUI (scuba) training instruction	100
				$300	Marine Programs	Advanced NAUI (scuba) course	12
				$200	Aquatics Hawaii, Inc.	Aquarium management	30

SHORT-TERM MARINE TRAINING PROJECTS

Private Industry	State	Federal other than Sea Grant (ONR, NSF, etc.)	Federal Sea Grant	Volunteer's time/Paid for by students	Sponsoring Institution	Activity	No. of Students
	$250				Zoology Department	Benthic biota survey Kailua Bay	3
		$12000		$500	NSF/State	Artificial reef project	5
$250					Neighbor Island Consultants	Benthic algae survey Kona coast	1
				$5000	University of Hawaii	Teaching assistants IS 298 course	5
				$800	Bernice P. Bishop Museum	Algae sampling	4

STUDENT-PROPOSED AND STUDENT-LED PROJECTS

Private Industry	State	Federal other than Sea Grant (ONR, NSF, etc.)	Federal Sea Grant	Volunteer's Time	Sponsoring Institution	Activity	No. of Students
	$288		$275	$1500	Marine Programs Department of Parks and Recreation	Development of Hanauma Bay underwater park tours	7
		$23,000		$500	NSF WRRC	Mokapu Outfall Baseline Study	30
		$2100			Marine Programs	Construction of underwater pipeline at Sand Island	5
				$1000	Marine Programs	High School Orientation Program for high school students conducted by Marine Option students	7

MARINE EXPERIENCE PROGRAM

Private Industry	State	Federal other than Sea Grant (ONR, NSF, etc.)	Federal Sea Grant	Volunteer's Time	Sponsoring Institution	Activity	No. of Students
	$400				Marine Programs	Sailing aboard the Barquentine California	150
	$100				Navy	Trip for diving demonstration at escape training tank, Pearl Harbor	50
	$100				Navy	Demonstration of dry-docking at Pearl Harbor	30
	$250				HIMB	Tours of Coconut Island, snorkeling tour of Kaneohe Bay (six trips)	200
		$12,000		$500	HIG	Shipboard orientation to oceanographic research techniques aboard R/V Teritu for high school and college students at Kawaihae, Hawaii (12 days ship time)	250 (Hilo Colleg 225 (High School
		$10,000		$1,000	HIG	High school and college students from Molokai, Maui, Oahu, Hawaii RV Teritu	775

ADMINISTRATIVE COSTS

Private Industry	State	Federal other than Sea Grant	Federal Sea Grant	Volunteer's Time	List of Personnel, Duties, and Length of Hire
	$3900		$13,156		Barry Hill - Assistant for Curriculum Development Director of Marine Option Program 3/1/72 - 8/31/72
	$654				Nancy Battaile - Administrative Assistant* (student help) 3/1/72-6/15/71
	$1500				Carrie Matsuzaki - Administrative Assistant* 9/1/71 - 5/30/72 (student help)
			$1270		Joan Matsuzaki - Administrative Assistant * 6/1/72 - 8/31/72 (student help)
			$341		Jo Anne Kushima - Public relations; publicity; newsletter publication* (student help) 1/1/72 - 5/30/72
			$520		Alan Hong - Public relations; publicity; newsletter publication* (student help) 6/1/72 - 8/31/72
	$50			$300	Donna Noborikawa - Coordinator, High School Orientation Group (student help) 6/1/72 - 8/31/72
		$1750			Robert Chase - Coordinator, Hilo College Marine Option Program 4/15/72 - 8/31/72
	$400				Christopher Potter - Organizer, Marine Science Information Center at Hilo College (student help) 7/1/72 - 8/31/72
				$800	Kelvin Char - Assistant to the Marine Option Director (student help) 12/1/72 - 8/31/72
	$600				John Ford - Biennial Report Coordinator 1/2/73 - 6/31/73

*None of these positions overlap.

EQUIPMENT

Private Industry	State	Federal other than Sea Grant	Federal Sea Grant	Donations	Articles
	$2250				Scuba equipment, underwater cameras, and other miscellanea
	$1600			$600	10-man rafts; life vests; floats; resuscitators Equipment for Hilo Marine Option Program

TRAVEL

Private Industry	State	Federal other than Sea Grant	Federal Sea Grant	Donations	Activity
	$1200				For two Marine Option students to meet the R/V Kana Keoki in Fiji for oceanographic technician training
	$300		$325		For Kelvin Char, Marine Option student, to accompany Dr. John Craven to Washington, D.C. and Houston, Texas to act as legislative aid
	$1000				For Barry Hill to establish the Hilo Marine Option Program and the Maui Marine Option Program
	$160				For fifteen Marine Option students to Kamuela, Hawaii to meet vessel for Kona sailing trek